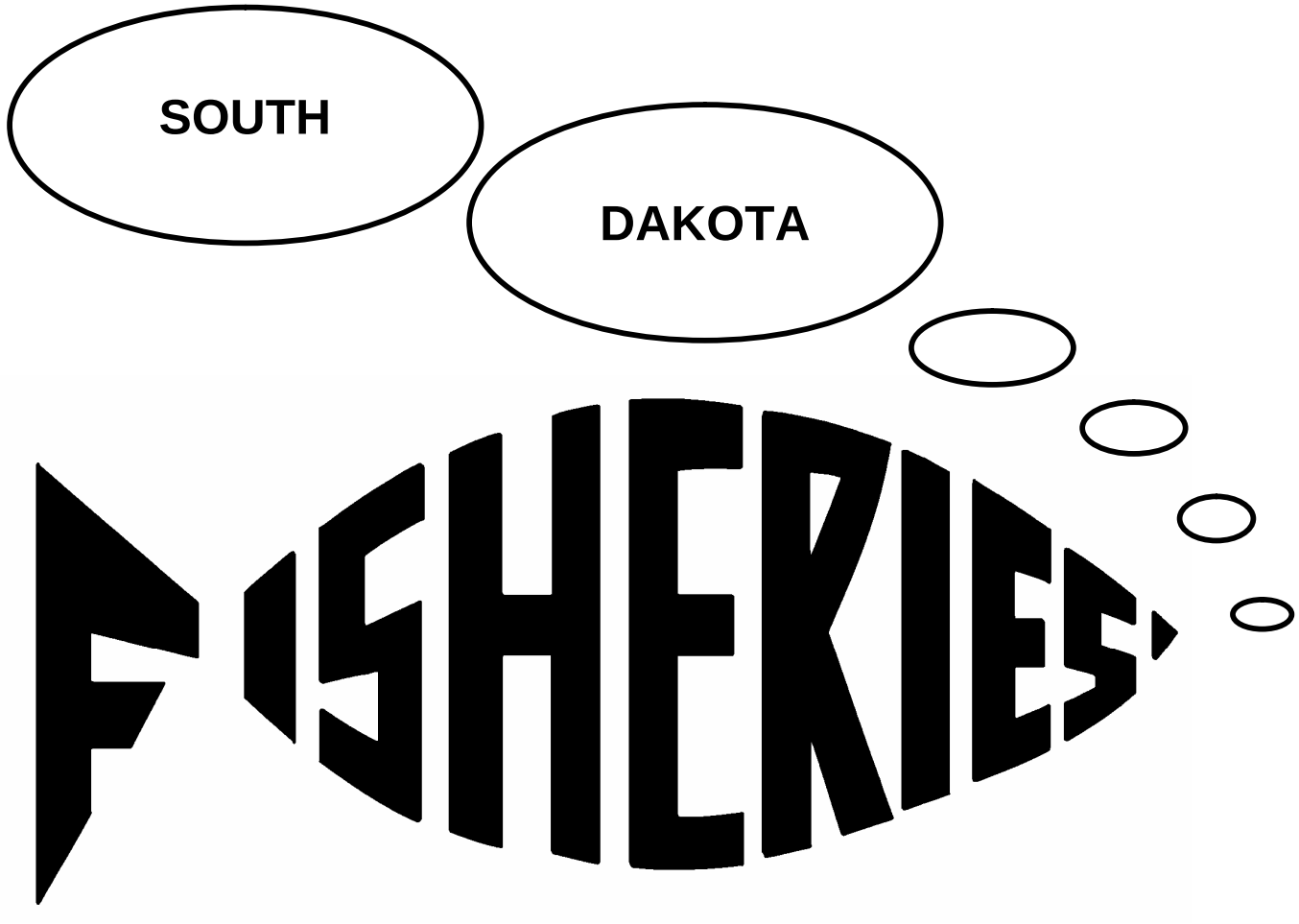

ANNUAL FISH POPULATION AND ANGLER USE, HARVEST AND PREFERENCES SURVEYS ON LAKE FRANCIS CASE, SOUTH DAKOTA, 2003

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Wildlife Division
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Pierre, South Dakota 57501-3182

Progress Report
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ANNUAL FISH POPULATION AND ANGLER USE AND SPORT FISH HARVEST SURVEYS ON LAKE FRANCIS CASE, SOUTH DAKOTA, 2003

by

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Annual Report

Dingell-Johnson Project----------F-21-R-36

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PREFACE

Information collected during 2003 is summarized in this report. Copies of this report and references to the data can be made with permission from the author or Director of the Division of Wildlife, South Dakota Department of Game, Fish and Parks, 523 E. Capitol, Pierre, South Dakota 57501-3182.

The author would like to acknowledge the following individuals from the South Dakota Department of Game, Fish and Parks who helped with administrating, data collection, editing, or manuscript preparation: Gerald Wickstrom, Gary Knecht, James Riis, Dennis Unkenholz, John Lott, Wayne Nelson-Stastny, Robert Hanten, Cliff Stone, Sandi Knippling, Darla Kusser, Tim Anderson, Michael Bertrand, Jared Caba, Casey Griffith, and Michael Weber.

The collection of data for these surveys was funded, in part, by Federal Aid in Sport Fish Restoration, (D-J) project F-21-R, "Statewide Fish Management Surveys". Some of these data have been presented previously in segments F-21-24 through 36.

EXECUTIVE SUMMARY

This report includes annual fish population and angler use and harvest data, from 1999 through 2003, for Lake Francis Case (LFC), South Dakota. These surveys, their results and interpretation, are major strategy and evaluation tools for planning efforts outlined in the Missouri River Fisheries Program Strategic Plan. Results and discussion presented pertain to changes in fish community and population characteristics, sport fishing use and harvest, and evaluation of management activities and regulations.

Walleye catch per unit of effort (CPUE; No./min.), during 2003 spring-spawning-run electrofishing near Chamberlain, decreased from 2002 and was the lowest of the five-year period. Walleye electrofishing CPUE at the face of Ft. Randall Dam increased from 2002, and was near the high end of the five-year period.

Fall gill netting collected sixteen fish species. Walleye CPUE (No./net night), in 2003, decreased over that observed in 2002, primarily due to the dwindling of a strong 2002 walleye year class, and is at a five year low. Sauger CPUE decreased from the 2002 value and is currently at a five-year low. Channel catfish CPUE equaled that of 2002, the highest of the five-year period. Mean white bass CPUE in 2003 declined from 2002. Smallmouth bass and yellow perch mean CPUEs in 2003 decreased from 2002 values and remained within their respective five-year ranges.

Fourteen species of age-0 fishes or small littoral prey species were collected by seining in 2003. Age-0 gizzard shad dominated 2003 seine catches, accounting for 94% of the total catch. Emerald shiners, freshwater drum, johnny darter, smallmouth bass, spottail shiners, walleye, white bass and yellow perch were also common in seine catches.

Walleye mean age, growth, and relative weight (Wr) in 2003 were all similar to previous year's values, while proportional stock density (PSD) and abundance decreased and survival increased from 2002 estimates. All sauger population parameter values were within the five-year ranges. The number of smallmouth bass collected in fall netting surveys was inadequate to allow meaningful population parameter comparisons.

Anglers spent an estimated 710,078 hours fishing LFC, during the April-September 2003 daylight period, similar to the 714,510 hours estimated for 2002 and over 200,000 hours less than the high estimated for 1999. Total fish harvest in 2003 was estimated at 205,705 fish. Walleye dominated the harvest, with an estimated harvest of 162,581 fish, similar to the 2002 estimate. Estimated mean length of harvested walleye was 40.7 cm (16.0 in). Channel catfish, white bass, sauger, and smallmouth bass were also common in the harvest. An overall catch rate (harvest and release rates combined) of over 1.1 fish/angler-h was estimated for the April-September 2003 daylight period. Total catch, release, and harvest rates for walleye were 0.89 walleye/angler-h, 0.66 walleye/angler-h, and 0.23 walleye/angler-h, respectively. Approximately 83% of LFC anglers expressed some degree of satisfaction with their angling trip. Anglers from South Dakota and 17 other states, fishing LFC, generated a local economic impact estimated at approximately 10.4 million dollars, in 2003. Results from several questions regarding LFC angler attitudes and preferences are reported.

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ANGLER USE AND SPORT FISH HARVEST SURVEYS
ON
LAKE FRANCIS CASE, SOUTH DAKOTA, 2003

INTRODUCTION

Lake Francis Case (LFC), a Missouri River mainstem reservoir, provides more than 100,000 angler days of recreation annually (Table 1). Overall, the river segments and reservoirs comprising the Missouri River system, in South Dakota, provide a large and diverse portion of the state's available fishing opportunity. The importance of this system to South Dakota anglers was documented in a 1992 Angler Use and Preference Survey (Mendelsohn 1994; Stone 1996a), in which 50 percent of the respondents listed the "Missouri River and its reservoirs" as their preferred fishing area. Recognizing the importance of the Missouri River, strategic planning efforts (SDGFP 1994) by the South Dakota Department of Game, Fish and Parks (SDGFP) have designated the Missouri River as a specific planning program within the overall planning effort.

Spanning 32,000 ha, LFC has in recent years supported over 200,000 angler trips annually (Table 1) (Stone and Sorensen 1999, 2000). Walleye, and to a lesser extent smallmouth bass, white bass and channel catfish, provide the majority of sport fishing opportunity available in this reservoir. Over the past 23 years, management of the walleye sport fishery has undergone several significant changes in response to changes in walleye population structure and angler use and harvest (Stone 1990; Stone et al. 1994; Stone and Sorensen 1999, 2001). Current sport fish management regulations for walleye/sauger and their hybrids for LFC include:

- daily and possession limits of 4 and 8 per angler, respectively.
- a minimum length limit of 381 mm (15 in.) for all months of the year except July and August.
- anglers are allowed only one walleye/sauger or hybrid per day longer than 457 mm (18 in.), year-round.
- anglers are not allowed to "cull" or "hi-grade" walleye/sauger or hybrids.
- anglers fishing through the ice in the lower half of the reservoir are required to keep the first four walleye/sauger or hybrids they catch and size restrictions do not apply.
- closed area: the area in the upper portion of the reservoir, between I-90 and the railroad bridge, referred to as the "dredge hole" is closed to fishing (except shore fishing on the Brule County side) during the months of January through April and December.

LFC anglers fishing in the late 1990s and early 2000s benefited from high walleye abundance resulting from conditions provided by unusually high water levels in 1995 and 1997. However, with water yield in the Missouri River Basin now entering the fourth consecutive year of below normal conditions, past research (Stone 1997b) and observations would suggest that it will be unrealistic to expect to maintain fish population abundance at the levels observed in the mid-to-late 1990s.

Maintaining LFC as one of South Dakota's productive fisheries resources requires that it be effectively managed to produce optimal recreational benefits, within the framework of protecting and maintaining the overall integrity of the aquatic community. The Missouri River Fisheries Program Strategic Plan (SDGFP 1994) documents the goal, objectives and strategies developed for management of this system. Annual acquisition and analysis of data describing the fish community and fish population parameters, in association with data describing angler use and sport fish harvest, is a primary strategy outlined in that plan. This work is required for evaluation of objectives and strategies outlined in that plan and as a prerequisite to effective development of future management strategies. This report describes data collected in 2003 from LFC and focuses the evaluation on changes in fish populations and associated angler use and sport fish harvest since 1999.

Table 1. Angler use and sport fish harvest statistics from creel surveys conducted on Lake Francis Case since 1954. TL = total length.

Year	Fishing pressure (h)	Angler days	Mean trip length (h)	Total fish harvest (No.)	Walleye harvest (No.)	Total harvest rate (Fish/ angler-h)	Walleye harvest rate (Fish/ angler-h)	Mean walleye TL(mm) in harvest	Reference
1954	84,000	35,000	2.4	115,000	0	1.369	0.000	-	Shields (1955)
1955	119,000	41,000	2.9	105,000	190	0.882	0.002	-	Shields (1956)
1956	159,000	47,500	3.4	89,500	177	0.563	0.001	-	Shields (1957)
1960	425,000	78,500	5.3	114,310	1,386	0.269	0.003	-	Nelson (1961)
1981*	565,890	99,280	5.7	173,730	145,412	0.307	0.257	-	Miller (1984)
1982	557,570	101,375	5.5	136,150	110,554	0.244	0.198	-	Miller (1984)
1983	425,060	74,570	5.7	102,070	70,434	0.240	0.166	-	Unkenholz et al. (1984)
1984	433,640	86,730	5.0	259,070	242,431	0.597	0.559	-	Stone (1985)
1989	604,100	115,290	5.2	289,854	222,008	0.480	0.368	340	Stone and Wickstrom (1991a)
1990	383,711	81,641	4.7	117,155	64,596	0.305	0.169	368	Stone and Wickstrom (1991b)
1991	409,600	87,521	4.7	139,600	95,298	0.341	0.233	381	Stone and Wickstrom (1992)
1992#	640,215	127,215	5.0	267,105	217,841	0.417	0.339	386	Stone et al. (1994)
1993	589,153	115,520	5.1	126,231	95,425	0.214	0.161	386	Stone et al. (1994)
1994	695,371	131,202	5.3	220,386	174,775	0.317	0.251	386	Stone (1995)
1995	543,414	113,923	4.8	185,354	158,354	0.341	0.292	391	Stone (1996b)
1996	856,421	190,316	4.5	324,221	274,339	0.379	0.320	383	Stone (1997a)
1997	652,510	143,409	4.6	307,297	285,463	0.471	0.437	385	Stone (1998)
1998	961,343	204,324	4.7	397,535	339,889	0.413	0.354	396	Stone and Sorensen (1999)
1999	997,871	212,902	4.7	359,440	285,186	0.360	0.286	417	Stone and Sorensen (2000)
2000	809,806	149,964	5.4	248,234	196,795	0.306	0.243	412	Stone and Sorensen (2001)
2001	780,962	152,830	5.1	242,869	199,372	0.311	0.255	409	Stone and Sorensen (2002)
2002	714,510	148,856	4.8	215,275	178,666	0.301	0.250	405	Stone and Sorensen (2003)
2003	710,078	139,231	5.1	205,705	162,581	0.290	0.229	411	this study

* Estimate projected from a creel survey for approximately 1/3 of reservoir.

Estimate was for May-August only.

OBJECTIVES

The objectives of the two main surveys discussed in this report are to provide information on or estimates of:

Annual Fish Population Surveys (Federal Aid Project 2102):

(1) species composition
(2) relative abundance
(3) condition
(4) age, growth, and recruitment
(5) survival and mortality rates
(6) population size structure
(7) effects of regulations
(8) effects of stocking and other management activities
(9) effects of sport fish harvest

Fish tagging was also conducted to provide information on fish movement and angler exploitation.

Angler Use and Sport Fish Harvest Survey (Federal Aid Project 2109):

(1) recreational angling pressure
(2) angler harvest, by species
(3) angler harvest, release and catch rates, by species
(4) mean angler party size, mean length of angler day and angler residency
(5) annual economic impact of this sport fishery
(6) effects of regulations
(7) effects of stocking and other management activities
(8) angler demographics
(9) angler preference, satisfaction and attitudes

STUDY AREA

Lake Francis Case is located in south-central South Dakota (Figure 1). Historical, biological, chemical and physical parameters have been discussed in North Central Reservoir Investigation reports (Benson 1968; Gasaway 1970; Walburg 1977). Table 2 presents selected physical characteristics and management statistics for Lake Francis Case.

Water yield in the Missouri River system in 2003 was below normal and was the fourth consecutive year of below normal inflow after six years of above normal yield (Appendix 1; U.S. Army Corps of Engineers, unpublished data). During the spring of 2003, the elevation of LFC increased as was forecasted by the U.S. Army Corps of Engineers (USCOE) until late April, when the USCOE began using water stored in LFC to support water releases downstream of Gavins Point Dam. Those releases resulted in the elevation of LFC declining by over 0.84 m (2.8 ft) by late May (Figure 2). The USCOE began refilling LFC in mid-June where it reached an elevation near 413 m msl (1354.3 ft.) by mid-July, where it remained until the annual fall draw-down began in mid September. Appendix 1 presents monthly data on water released from Ft. Randall Dam.

Figure 1. Lake Francis Case study area.

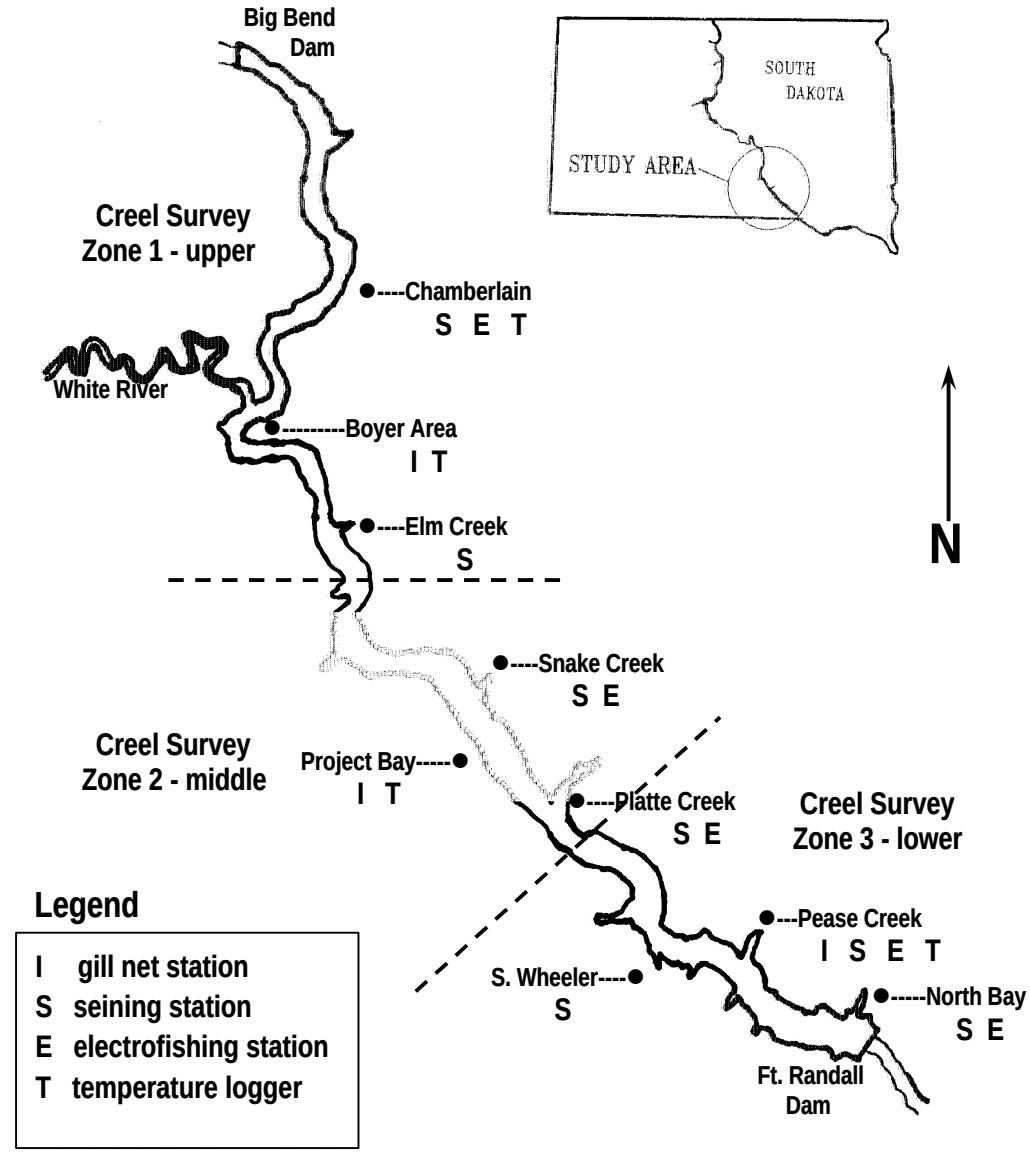


Table 2. Physical characteristics at base of flood control, management classification, and sampling times and depths for annual fish population surveys on Lake Francis Case.

	Lake Francis Case
Location:	From Pickstown to Ft. Thompson, SD
Surface Area (x 1000 ha):	32.0
Depth (m) - maximum: - mean:	42.6 15.2
Bottom:	Sand, gravel, shale and silt
Water source:	Missouri River and tributaries
Management classification:	Cool and warm water permanent
Electrofishing - walleye - smallmouth bass	April, May May, June
Gill net depths:	0-12 m (0-40 ft) 12-24 m (40-80 ft) 24-37 m (80-120 ft)
Number of gill nets:	27
Gill net date:	September
Seine date:	July

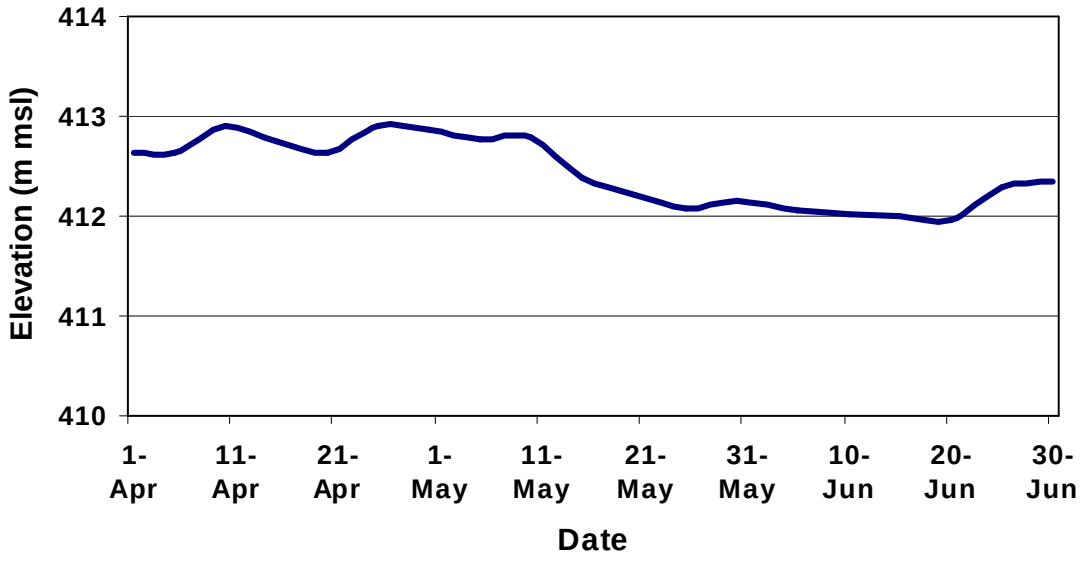


Figure 2. Spring 2003 Lake Francis Case reservoir elevation.

SAMPLING METHODS AND SCHEDULE

FISH POPULATION SURVEYS AND ASSOCIATED WORK ACTIVITIES

Data Collection

Gill nets, seines, and electrofishing were used to sample fish populations in LFC at locations identified in Figure 1. Three variable-mesh standard gill nets (Lott et al. 1994) were fished overnight, on the bottom, in one embayment and in each depth zone (where possible), at each station (Table 2). All fish species collected were identified, counted, measured for total length (TL; mm) and weighed (g). Scale samples (100 per species per sampling location) were collected from walleye, sauger, smallmouth bass and white bass, where possible.

Pulsed-DC (60 pps, 6-8 amps) electrofishing, using a Smith Root GPP electrofishing boat, was used to collect walleye during April and smallmouth bass during May and June, for population monitoring (fish/min) and tagging studies. Nine and six, 10-minute electrofishing runs were conducted at night near Chamberlain and off the face of Ft. Randall Dam, respectively, to collect walleye. Smallmouth bass were collected at five locations: Chamberlain, Big Bend Dam tailwater, Platte Creek, Pease Creek and near Ft. Randall Dam (Figure 1). Three, 30-minute electrofishing runs were conducted at each sampling location. All fish were measured for total length.

Nylon seines, previously described by Lott et al. (1994), were used to collect age-0 fishes and small littoral species. A quarter-arc seine haul was accomplished by methods described in Martin et al. (1981). Four seine hauls were made at each sampling station; two on each side of the reservoir. All fish collected with seines were identified to species and counted. Walleye were measured for total length.

Water temperature data was collected with submersible HOBO Water Temp Pro temperature loggers. Loggers, configured to record temperature every two hours, were deployed at four locations (Figure 1) on the reservoir between March 31 and April 14, 2003 and retrieved between September 22 and September 23, 2003.

A list of common names, scientific names, and abbreviations of fish mentioned throughout this report is presented in Appendix 2.

Data Analysis

Relative abundance of fish species was expressed as mean catch per unit effort (CPUE) for standard gill net (No./net night), electrofishing (No./min.), and seine catches (No./haul). Age and growth analyses were completed for walleye, sauger and smallmouth bass. Scales were aged according to standard techniques (DeVries and Frie 1996). Back-calculations were made with the computer program WINFIN (Francis 1999, 2000). Standard y-intercept values, suggested by Carlander (1982), were used for walleye (55 mm), sauger (55 mm), and smallmouth bass (35 mm). Age distributions from gill net catches were developed, for selected species, by aging approximately 100 fish per sampling station (when available). Proportional stock density (PSD) and relative stock density (RSD) values for preferred- (RSD-P) and memorable- (RSD-M) length fish were calculated for channel catfish, sauger, smallmouth bass, walleye, white bass, and yellow perch (Anderson and Weithman 1978; Gabelhouse 1984). Length categories (Gabelhouse 1984) used to calculate PSD and RSD are listed in Table 3.

Table 3. Minimum lengths (mm) of length class designations (Gabelhouse 1984).

Species	Stock	Quality	Preferred	Memorable	Trophy
Walleye	250	380	510	630	760
Sauger	200	300	380	510	630
Smallmouth Bass	180	280	350	430	510
Channel Catfish	280	410	610	710	910
White Bass	150	230	300	380	460
Yellow Perch	130	200	250	300	380

Relative weight (W_r; Anderson 1980), for stock-to-quality (S-Q), quality-to-preferred (Q-P), and preferred-length (P) fish (Table 3) was calculated using length designations established by Gablehouse (1984). Relative weight (W_r) values were generated using standard weight (W_s) equations developed for walleye (Murphy et al. 1990), sauger (Guy et al. 1990), smallmouth bass (Kolander and Willis 1991), channel catfish (Brown et al. 1995), yellow perch (Willis et al. 1991), and white bass (Brown and Murphy 1991). Standard weight equations used in this report are provided in Appendix 3. Mean W_r values were tested for differences among length-class designations using a one-way analysis of variance (SYSTAT, 1998). A mean W_r value for stock-length fish is reported when no significant differences were detected among length categories. Statistical significance was set at $P < 0.05$.

Length-weight regression equations were developed for walleye, sauger, and smallmouth bass using Systat 8.0 (SYSTAT 1998). The equations are presented in Appendix 4.

Survival and mortality estimates for walleye, sauger, and smallmouth bass were calculated using catch curves (Ricker 1975). To reduce the effects of variable recruitment, two consecutive years of age-distribution data, from the gill net survey, were combined for analysis. Catch curves were analyzed to determine the age at which each species was fully recruited to the sampling gear. To estimate instantaneous mortality rates (Z), the slope of the regression of the natural logarithm of the number of fish of each age on fish age was used.

ANGLER USE AND SPORT FISH HARVEST SURVEY

A bus route creel survey design (Soupir and Brown 2002; Jones and Robson 1991), first utilized in 2000 (Stone and Sorensen 2001), was conducted to estimate angler use and harvest on LFC**.** Prior to 2000, fishing pressure was estimated by either aerial counts of fishing boats and shore anglers (Schmidt 1975) or by ground counts of boat trailers and shore anglers (Stone and Sorensen 1999). A bus route design is a modified access survey typically used for fisheries with numerous access sites spread over a broad geographical region (Robson and Jones 1989; Jones et. al. 1990). For a more detailed description of the bus route theory and techniques see Robson and Jones (1989), Jones and Robson (1991) and Pollock et al. (1994). Estimates of angler catch, harvest, and release rates, along with information on mean party size, mean angler day length, angler residency, and angler age distribution were collected by interviewing anglers. Total fish catch, harvest and release estimates were calculated by multiplying the pressure estimate (angler hours) by the estimated catch, harvest, or release rate (fish/angler-h). Despite the modification to the fishing pressure estimate technique, the survey design provides statistics comparable to those previously determined for LFC (Miller 1984; Unkenholz et al. 1984; Stone 1985; Stone and Wickstrom 1991a, 1991b, 1992; Stone et al. 1994; Stone 1995, 1996b, 1997, 1998; Stone and Sorensen 1999, 2000, 2001, 2002).

Sampling was conducted from 1 April 2003 through 30 September 2003, for the daylight period (sunrise to sunset). Creel zones are identified in Figure 1.

ANGLER PREFERENCE AND ATTITUDE SURVEY

A series of questions were selected by SDGFP reservoir fisheries biologists and human dimensions staff to measure angler satisfaction, preferences, and attitudes on several management issues. Questions selected were those thought to have a direct relationship to current reservoir fisheries management.

Questions were asked of individual anglers by incorporating two different sets of questions into routine creel-survey-interview forms. One person, from each angling party, was asked one series of questions. The questions appeared on an alternating basis, on creel survey interview forms, in an attempt to reduce duplication in subsequent interviews. Responses were encoded into a database for summary and analysis.

WALLEYE HARVEST MANAGEMENT SURVEY

A series of questions were selected by SDGFP reservoir fisheries biologists to obtain thoughts and preferences, from Lake Francis Case anglers, pertaining to walleye harvest management and managing for large walleye in Lake Francis Case. Postage paid questionnaires, providing background information on the Lake Francis Case walleye population, current management issues, and options for regulation changes, were printed and distributed by survey clerks as part of the angler use and harvest survey, and at bait shops along the entire length of the reservoir. Responses were encoded into a database for summary and analysis.

RESULTS

FISH POPULATION SURVEYS AND ASSOCIATED WORK ACTIVITIES

Species Composition and Relative Abundance

Results of spring electrofishing, conducted to monitor the timing and abundance of spawning walleye, are presented in Tables 4 - 6. Overall walleye electrofishing CPUE in 2003, near Chamberlain, decreased and was the lowest observed over the last five years (Table 4). Sampling near Ft. Randall Dam, during 2003, yielded the second highest CPUE of the five-year period (Table 5). The 2003 Ft. Randall spring walleye electrofishing CPUE was statistically similar ($P > 0.05$) to the previous two years, with the 2001 and 2003 values being significantly higher ($P < 0.05$) than the 1999 and 2000 values (Table 5).

Table 4. Electrofishing catch of walleye during spring-spawning-run sampling from Lake Francis Case, near Chamberlain, 1999-2003. Catch per unit effort (CPUE) values with the same letter code are not significantly different at the *P* = 0.05 level.

Year	Sampling time (min)	Number of fish	CPUE (fish/min)
1999	50*	710	14.2 a
2000	65	707	10.9 a
2001	83	777	9.4 a
2002	50	623	12.5 a
2003	70	628	9.0 a

* only two sampling runs were completed on 4-12-99 due to inclement weather

Table 5. Electrofishing catch of walleye during spring-spawning-run sampling from Lake Francis Case, near Ft. Randall Dam, 1999-2003. Catch per unit effort (CPUE) values with the same letter code are not significantly different at the *P* = 0.05 level.

Year	Sampling time (min)	Number of fish	CPUE (fish/min)
1999	142	295	2.1 a
2000	80	183	2.3 a
2001	66	344	5.2 b
2002	120	445	3.7 ab
2003	90	431	4.8 b

Table 6. Electrofishing data, by location and date, for walleye from Lake Francis Case, 2003. Catch per unit effort (CPUE) values, by location, with the same letter code are not significantly different at the *P* = 0.05 level.

Location	Date	Water temp. (C)	Sampling time (min)	No. of fish	CPUE (fish/min)
Chamberlain	4/14/03	10.1	25	209	8.4 a
Chamberlain	4/21/03	8.3	30	227	7.6 a
Chamberlain	4/28/03	12.0	15	192	12.8 b
Ft. Randall Dam	4/22/03	7.0	45	199	4.4 a
Ft. Randall Dam	4/27/03	8.1	45	232	5.1 a

Table 7 presents results of electrofishing sampling for smallmouth bass in LFC. Catch-per-unit-effort values, while not statistically different, increased at four of the five sampling stations. However, with the exception of Ft. Randall Dam, most smallmouth bass spring electrofishing CPUE's were near the low end of the sampling range over the past three-to-five years (Table 7).

Table 7. Electrofishing catch of smallmouth bass during spring sampling, at five locations on Lake Francis Case, 1999-2003. Catch per unit effort (CPUE) values with the same letter code are not significantly different at the $P = 0.05$ level.

Chamberlain			
Year	**Sampling time (min)**	**Number of fish**	**Fish/min**
1999	30	162	5.4 a
2000	30	108	3.6 ab
2001	45	45	1.0 b
2002	49	75	1.5 b
2003	45	122	2.7 ab
Big Bend Dam Tailwaters			
Year	**Sampling time (min)**	**Number of fish**	**Fish/min**
2001	60	49	0.8 a
2002	90	126	1.4 a
2003	60	112	1.9 a
Platte Creek			
Year	**Sampling time (min)**	**Number of fish**	**Fish/min**
1999	30	35	1.2 a
2000	90	67	0.7 a
2001	60	32	0.5 a
2002	90	12	0.1 a
2003	90	83	0.9 a
Pease Creek			
Year	**Sampling time (min)**	**Number of fish**	**Fish/min**
1999	60	60	1.0 a
2000	45	27	0.6 a
2001	60	28	0.5 a
2002	90	50	0.6 a
2003	90	102	1.1 a
Ft. Randall Dam			
Year	**Sampling time (min)**	**Number of fish**	**Fish/min**
1999	30	104	3.5 a
2000	60	115	1.9 a
2001	60	76	1.3 a
2002	90	232	2.6 a
2003	90	175	1.9 a

Fall gill-net sampling collected 16 species of fish from LFC in 2003 (Table 8). All species had been previously reported (Lott et al. 1994). Walleye have been the most common species in the gill net catch since re-initiation of this survey in 1981 (Michaletz et al. 1986; Lott et al. 1994), and accounted for 36% of the gill net catches in 2003, followed by channel catfish and sauger, which accounted for 21% and 15% of the catch, respectively. White bass, gizzard shad, goldeye and smallmouth bass were also common in the gill-net catch during 2003.

Walleye CPUE in gill nets, in 2003, decreased from the previous year CPUE value and was at a five-year low (Table 8). This decrease in abundance can be attributed primarily to the low recruitment of an initially strong 2002 year-class of walleye into the population in 2003.

Channel catfish CPUE in gill nets, for 2003, was similar to other years in the five-year period. Sauger CPUE for 2003 decreased from the high of 6.3 fish/net night recorded in 2002 to 4.0 fish/net night, the lowest of the five-year period. Smallmouth bass gill net CPUE also decreased from the previous year but remained within the five-year range. Yellow perch and white bass CPUE's were in the upper end of the five-year sampling period range.

Fourteen species of age-0 fishes or small littoral species were collected by seining in 2003 (Table 9). All species had been previously reported for LFC (Lott et al. 1994). Age-0 gizzard shad comprised the majority of the seine catches, as they have for the past five years, and accounted for 94% of the total seine catch. Emerald shiners, spottail shiners, white bass, freshwater drum, johnny darters, yellow perch, walleye, and smallmouth bass, which comprised about 6% of the total catch, were also common in seining efforts.

The age-0 walleye seining CPUE decreased for the second consecutive year to 2.3 fish/seine haul in 2003. Age-0 walleye collections in 2003 followed a normal LFC pattern, with 88% of the fish collected in the upper half of the reservoir. Walleye collected in seines averaged 88.2 mm (Table 10), an increase for the second consecutive year. Figure 3 presents a length frequency histogram of walleye from 2003 seining efforts.

Table 8. Mean gill net catch per lift (CPUE; No./net night), sampling stations combined, on Lake Francis Case, 1999-2003. SE is standard error. Trace (T) < 0.1.

Species	1999		2000		2001		2002		2003	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Black bullhead	2.9	0.6	0.2	0.1	0.0		0.0		0.0	
Channel catfish	5.3	0.8	4.1	0.5	4.4	0.5	5.6	0.6	5.6	0.9
Common carp	2.5	0.5	1.1	0.3	0.9	0.3	1.8	0.4	0.9	0.2
Emerald shiner	0.0		T	-	T	-	0.0		T	-
Freshwater drum	2.0	0.5	1.2	0.3	1.1	0.3	0.7	0.2	0.3	0.1
Gizzard shad	5.1	1.4	4.3	3.6	12.0	3.8	1.8	0.8	1.1	0.7
Goldeye	0.9	0.3	2.0	0.7	2.2	0.9	1.0	0.4	1.2	0.4
Northern pike	0.4	0.1	0.1	0.1	T	-	T	-	0.0	
Rainbow trout	0.0		0.0		T	-	0.0		0.0	
River carpsucker	0.3	0.1	0.2	0.1	0.2	0.1	0.3	0.2	0.1	0.1
Sauger	5.1	0.9	5.5	0.6	4.9	0.7	6.3	1.0	4.0	0.6
Shorthead redhorse	0.1	0.1	0.1	0.1	0.2	0.1	0.3	0.1	0.0	
Shortnose gar	T	-	0.1	0.1	0.1	0.1	0.0		0.2	0.1
Shovelnose sturgeon	0.0		T	-	T	-	0.0		0.0	
Smallmouth bass	0.6	0.3	0.9	0.4	0.6	0.2	1.4	0.6	0.9	0.3
Smallmouth buffalo	T	-	T	-	0.0		T	-	0.1	0.1
Spottail shiner	0.0		T	-	T	-	T	-	0.2	0.2
Walleye	17.4	2.3	21.6	3.3	11.3	1.1	15.9	2.0	9.6	1.0
White bass	0.6	0.3	1.1	0.3	4.2	1.1	0.9	0.2	1.6	0.4
White crappie	0.9	0.3	0.1	0.1	0.7	0.3	0.1	0.1	0.1	0.1
Yellow perch	1.5	0.4	0.9	0.3	0.3	0.1	0.6	0.1	1.0	0.3

Table 9. Mean catch per seine haul (CPUE; No./haul), sampling stations combined, of age-0 fishes and small littoral species from Lake Francis Case, 1999-2003. SE is standard error. Trace (T) < 0.1

Species	1999		2000		2001		2002		2003	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Bigmouth buffalo	0.0		0.0		T	-	0.0		0.0	
Black bullhead	25.9	25.4	0.0		0.0		0.0		0.0	
Black crappie	0.0		T	-	T	-	0.0		0.0	
Channel catfish	0.0		T	-	0.2	0.2	0.0		0.0	
Common carp	0.0		0.0		0.5	0.4	0.1	0.1	0.0	
Common shiner	T	-	1.2	0.6	0.3	0.3	0.0		0.2	0.2
Emerald shiner*	50.3	21.6	72.8	20.0	35.4	12.8	26.9	8.9	22.0	8.4
Fathead minnow*	10.9	5.1	0.1	0.1	1.7	1.0	T	-	0.1	0.1
Freshwater drum	0.4	0.2	2.0	1.6	0.5	0.3	1.0	0.6	6.3	3.5
Gizzard shad	544.7	391.6	202.0	101.6	793.7	495.1	3659.1	1610.8	934.2	299.3
Goldeye	0.0		0.3	0.1	0.3	0.3	T	-	0.0	
Johnny darter*	1.0	0.5	2.3	0.9	3.2	1.4	0.4	0.3	5.4	2.5
Largemouth bass	0.0		0.0		0.0		0.0		0.0	
North. redbelly dace	0.0		0.0		T	-	0.0		0.0	
Red shiner*	1.6	1.0	0.2	0.2	0.6	0.3	0.4	0.2	0.1	0.1
River carpsucker	0.0		T	-	0.2	0.2	0.3	0.1	0.1	0.1
Sauger	0.0		0.0		0.3	0.2	T	-	0.0	
Shorthead redhorse	0.0		0.0		T	-	0.0		0.0	
Silvery minnow	0.8	0.7	0.2	0.1	0.0		0.0		0.1	0.1
Smallmouth bass	2.7	1.2	1.3	0.4	1.5	0.7	1.8	0.7	1.3	0.4
Smallmouth buffalo	0.0		0.2	0.2	1.8	0.8	T	-	0.0	
Spottail shiner*	12.2	5.7	10.8	7.7	33.4	12.5	3.3	1.3	11.5	2.7
Walleye	0.1	0.1	1.1	0.5	11.9	4.7	3.5	1.3	2.3	1.3
White bass	10.1	5.5	59.1	33.0	389.1	130.0	65.1	23.4	11.2	5.4
White crappie	0.0		0.0		0.2	0.1	0.0		0.0	
Yellow perch	2.2	1.1	18.7	5.5	41.2	25.7	10.0	4.6	3.6	1.4

- includes both age-0 and adults

Table 10. Number (No.), catch per unit effort (CPUE; No./haul), mean total length (TL) and length range for age-0 walleye collected by seines from Lake Francis Case, 1999 – 2003.

Year	No.	CPUE	Mean TL (mm)	Total length (mm) range
1999	3	0.1	N/A	N/A
2000	30	1.1	67.5	58 - 83
2001	322	11.9	68.3	41 - 91
2002	95	3.5	80.0	63 - 109
2003	65	2.4	88.2	62-103

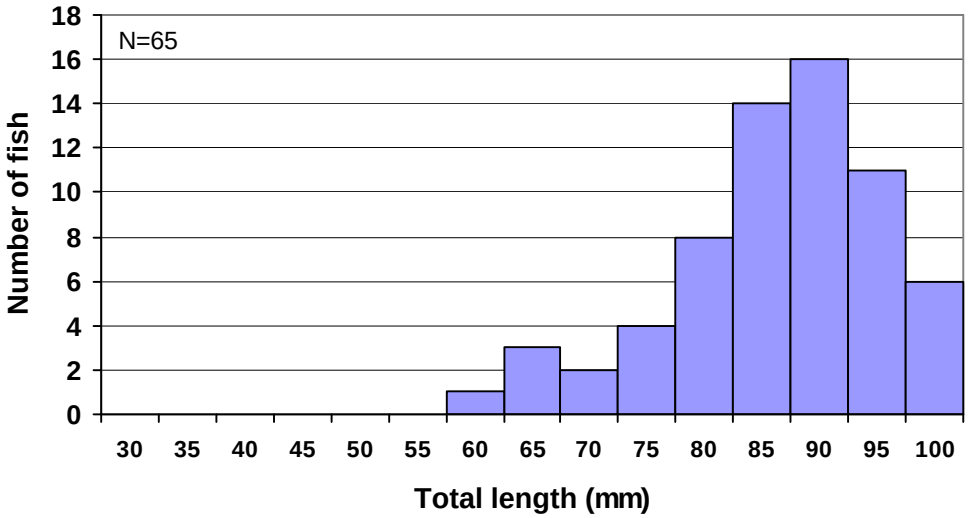


Figure 3. Length frequency of age-0 walleye collected with seines from Lake Francis Case, 2003. N = sample size.

Population Parameters for Walleye

Walleye growth, during 2002 (the last full year that growth could be calculated), was within the range of previous years for all age-classes (Table 11). Back-calculated length-at-age estimates are provided in Table 12. One concern with the use of minimum length limits is a reduction in growth rates resulting in "stockpiling" of fish just below the minimum length limit (Noble and Jones 1993). Current LFC length-at-age data suggests that stockpiling is not occurring. Mean walleye age in gill net samples, at 2.2 years, is similar to values generated for 2000-2002. Mean age values closer to 1.5 signify a high percentage of age-1 fish in the gill net sample, as occurred in 1999 (Table 13). Walleye from eight year-classes were collected in the 2003 gill net survey (Table 13) and ranged in TL from 120-mm to 710-mm (Figure 4).

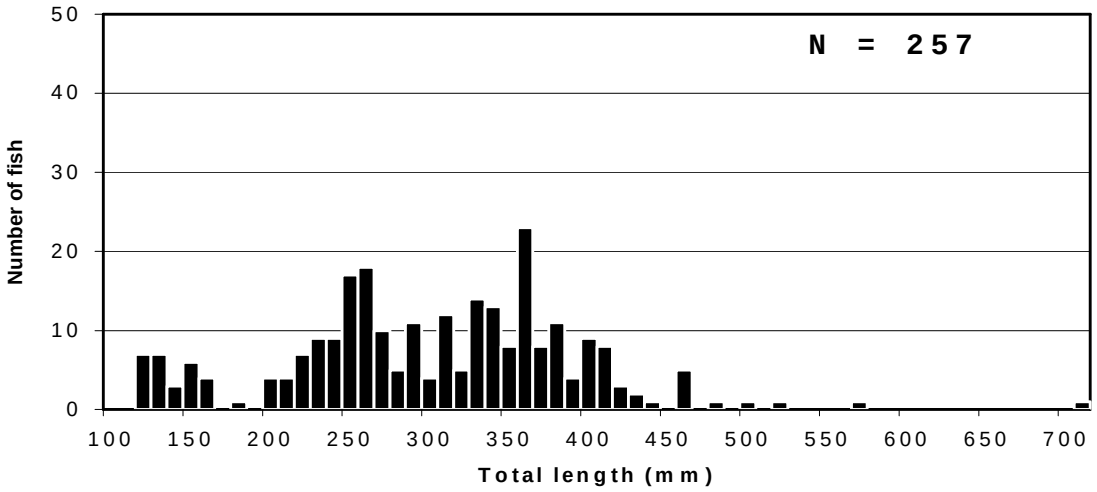


Figure 4. Length frequency of walleye collected with gill nets from Lake Francis Case, 2003. N = sample size.

Annual survival, for pooled 2002 and 2003 data, was estimated at 47% (Table 14), the highest of the five-year range. Relative weights for S-Q length and Q-P length fish sampled in 2003 were similar to previous years (Table 15). The 2003 walleye PSD (Table 16) of 24 was among the lowest values for the five-year period.

Table 11. Mean annual growth increments (mm) of back-calculated total lengths for each year class of walleye collected with variable-mesh gill nets during September 2003 from Lake Francis Case. N = sample size.

Year Class	Age	N	Growth increment at age										
			1	2	3	4	5	6	7	8	9	10	11
2002	1	93	170										
2001	2	59	128	145									
2000	3	46	147	122	71								
1999	4	19	136	114	78	50							
1998	5	4	133	118	72	50	29						
1997	6	3	145	114	102	43	38	22					
1996	7	3	155	98	59	78	60	28	39				
1995	8	-	-	-	-	-	-	-	-	-			
1994	9	-	-	-	-	-	-	-	-	-	-		
1993	10	-	-	-	-	-	-	-	-	-	-	-	
1992	11	1	149	103	88	71	29	114	56	28	39	16	12
All classes			145	113	76	57	43	65	64	75	39	16	12
N		228	228	135	76	30	11	7	4	1	1	1	1

Table 12. Mean annual back-calculated total lengths (mm) for each year class of walleye collected with variable-mesh gill nets during September 2003 from Lake Francis Case. N = sample size.

Year Class	Age	N	Back-calculated length at age										
			1	2	3	4	5	6	7	8	9	10	11
2002	1	93	170										
2001	2	59	128	273									
2000	3	46	147	269	340								
1999	4	19	136	250	328	378							
1998	5	4	133	251	323	373	402						
1997	6	3	145	259	361	404	442	464					
1996	7	3	155	253	312	390	450	478	517				
1995	8	-	-	-	-	-	-	-	-	-			
1994	9	-	-	-	-	-	-	-	-	-	-		
1993	10	-	-	-	-	-	-	-	-	-	-	-	
1992	11	1	149	252	340	411	440	554	610	638	677	693	705
All classes			145	258	334	391	434	499	563	638	677	693	705
N		228	228	135	76	30	11	7	4	1	1	1	1

Table 13. Age distribution of walleye collected from Lake Francis Case with variable-mesh gill nets, 1999-2003. Mean age excludes age-0 fish.

Year	Age												
	0	1	2	3	4	5	6	7	8	9	10	11	Mean
1999	85	193	97	50	28	10	6	2	1	0	0	0	1.6
2000	59	107	206	134	28	36	8	2	1	0	0	0	2.2
2001	16	77	112	54	34	3	4	1	0	0	0	0	2.3
2002	117	100	101	71	26	7	1	0	0	0	0	1	2.2
2003	27	93	59	46	19	4	3	3	0	0	0	1	2.1

Table 14. Estimates of annual survival (S), annual mortality (A), and instantaneous mortality rates (Z) for age-1-and-older fish of selected species, from Lake Francis Case. Years indicate which years of annual gill net survey data were combined for analysis.

Species	Years	S	A	-z	R^2
Walleye	1998-1999	0.42	0.58	0.870	0.971
	1999-2000	0.46	0.54	0.767	0.953
	2000-2001	0.43	0.57	0.846	0.911
	2001-2002	0.39	0.61	0.940	0.916
	2002-2003	0.47	0.53	0.755	0.955
Sauger	1998-1999	0.35	0.65	1.049	0.896
	1999-2000	0.34	0.66	1.078	0.887
	2000-2001	0.36	0.64	1.018	0.918
	2001-2002	0.31	0.69	1.166	0.839
	2002-2003	0.34	0.66	1.082	0.861
Smallmouth bass	1998-1999	0.44	0.56	0.813	0.928
	1999-2000	0.65	0.35	0.424	0.542
	2000-2001	0.49	0.51	0.723	0.565
	2001-2002	0.54	0.46	0.607	0.820
	2002-2003	0.45	0.55	0.788	0.853

Table 15. Mean relative weight, by length category, for Lake Francis Case walleye, sauger, and smallmouth bass, 1999-2003. S-Q = stock-to- quality length, Q-P = quality-to-preferred length, P = preferred length. *N* = sample size.

Walleye				
Year	**S-Q**	**Q-P**	**P**	***N***
1999	82	81	72	278
2000	83	82	78	482
2001	82	83	78	243
2002	83	81	86	274
2003	81	80	73	196
Sauger				
Year	**S-Q**	**Q-P**	**P**	***N***
1999	78	78	79	117
2000	74	72	69	146
2001	74	76	75	128
2002	76	73	73	119
2003	74	73	69	88
Smallmouth bass				
Year	**S-Q**	**Q-P**	**P**	***N***
1999	103	106	-	13
2000	118	111	109	23
2001	111	110	119	12
2002	111	107	101	29
2003	111	110	-	20

Table 16. Walleye, sauger, and smallmouth bass proportional stock density (PSD) and relative stock density for preferred- and memorable-length fish (RSD-P and RSD-M, respectively), for Lake Francis Case gill net data, 1999-2003.

Species	1999	2000	2001	2002	2003
Walleye	27 (5,0)	37 (3,0)	34 (0,0)	34 (1,0)	24 (1,0)
Sauger	56 (27,1)	56 (21,0)	69 (17,0)	63 (20,0)	51 (18,0)
Smallmouth bass	15 (0,0)	61 (9,0)	50 (8,0)	35 (7,0)	25 (0,0)

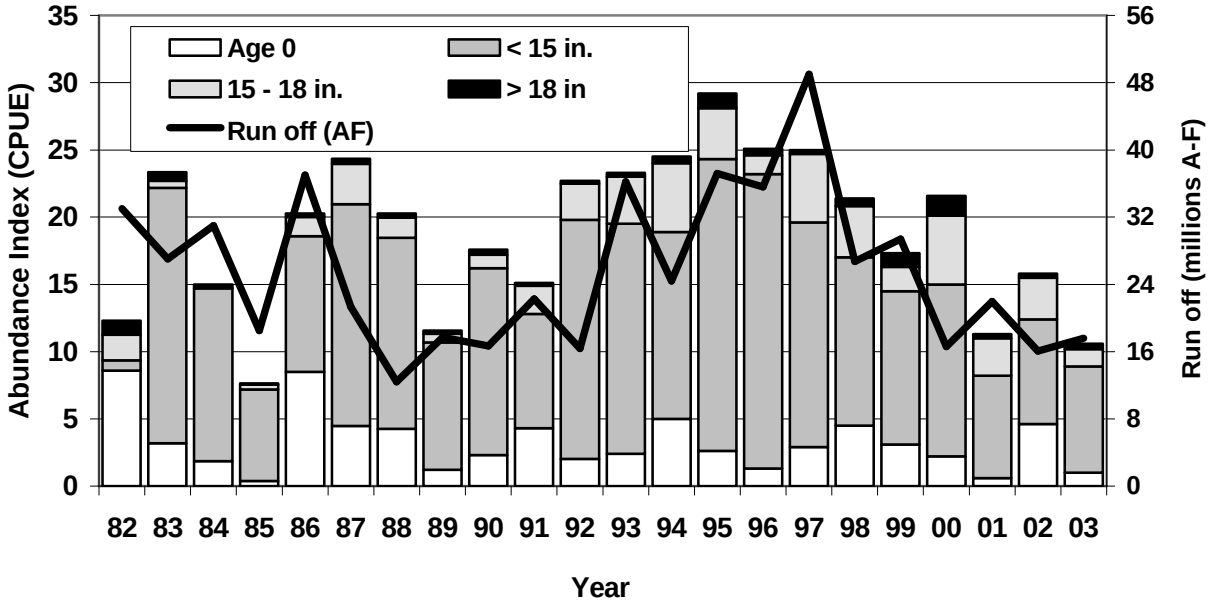
Data on walleye tagged in LFC during the 1999-2002 period are presented in Table 17. No walleye were tagged during 2003. During 2003, anglers returned (harvested fish) an additional 5.5% of the 2002 tags, 3.0% of the 2001 tags, 0.8% of the 2000 tags and 0.5% of the 1999 tags (Table 17). Despite only larger fish being tagged in 2002, tag recovery percentages from harvested fish, through the first and second year after tagging, were similar to previous tagging efforts (Table 17) by both location and total number returned. In addition to the walleye being reported as harvested, an additional 1.0% of the 2002 tagged fish, 0.5% of the 2001 tagged fish, 0.1% of the 2000 tagged fish and 0.2% of the 1999 tagged fish were reported as being caught and released at least one time.

Table 17. Number of walleye tagged, by location, and angler tag returns (number and percent of total number tagged), from harvested fish, Lake Francis Case, 1999–2003.

Tagging locations	Number	Tags returned											
		Year returned										Cumulative	
		1999		2000		2001		2002		2003			
1999 tags	tagged	No.	%	No.	%	No.	%	No.	%	No.	%	Total	%
Chamberlain	1047	94	9.0	57	5.4	41	3.9	11	1.1	4	0.4	207	19.8
Ft. Randall Dam	300	35	11.7	13	4.3	13	4.3	3	1.0	3	1.0	67	22.3
Total	1347	129	9.6	70	5.2	54	4.0	14	1.0	7	0.5	274	20.3
2000 tags													
Chamberlain	999			96	9.6	84	8.4	12	1.2	7	0.7	199	19.9
Ft. Randall Dam	200			25	12.5	16	8.0	2	1.0	2	1.0	45	22.5
Total	1199			121	10.1	100	8.3	14	1.2	9	0.8	244	20.4
2001 tags													
Chamberlain	999					117	11.7	45	4.5	28	2.8	190	19.0
Ft. Randall Dam	300					42	14.0	16	5.3	11	3.7	69	23.0
Total	1299					159	12.2	61	4.7	39	3.0	259	19.9
2002 tags													
Chamberlain	140							13	9.3	4	2.9	17	12.1
Ft. Randall Dam	61							4	6.6	7	11.5	11	18.0
Total	201							17	8.5	11	5.5	28	13.9

Figure 5 presents yearly total walleye abundance (CPUE), as indexed by fall gill netting, partitioned by selected age and size groups and plotted with total runoff (millions of acre-feet) into the Missouri River system above Sioux City, IA. Two factors have been credited for the improvements in walleye abundance and age structure, that was observed through the mid-1990's. First, walleye population parameter improvements were noted soon after sport-fishing-regulation changes were implemented in 1990 (Stone and Wickstrom 1991a). The population positively responded to habitat/nutrient conditions provided by the high runoff into the Missouri River system during 1993–1997 (Stone 1997b). The general decline in overall walleye abundance beginning in 1996 through this current survey can be attributed to high angler harvest coupled with declining habitat conditions, as Missouri River water yield returned to more normal levels in 1998 and 1999 followed by four consecutive years of drought conditions. While the 2003 walleye population abundance has decreased over that observed in the fall of 2002, most of that decrease can be attributed to the absence of a strong 2002 walleye year class coupled with low abundance of age-0 fish in 2003. A decrease in the abundance of 15-18 inch walleye also added to the overall decline in abundance.

Figure 5. Lake Francis Case total walleye abundance and abundance of walleye age 0, less than 381 mm (15 in.), 381- 457 mm (15 - 18 in.), and greater than 457 mm (18 in.), plotted against total runoff (millions of acre-feet) into the Missouri River system above Sioux City, IA. 1982-2003.



Population Parameters for Sauger

Sauger abundance in LFC, at a mean CPUE of 4.0 fish/net night in 2003, decreased from 2002, and was the lowest recorded for the five-year reporting period (Table 8). Lengths of sauger sampled in the 2003 gill net survey ranged from 120 mm to 470 mm TL (Figure 6). Sauger growth increments and back-calculated length-at-age during 2002 (the last full year that growth could be calculated) are presented in Tables 18 and 19. Mean sauger W_r values, for the various length categories are within the five-year range (Table 15).

Four year classes of sauger were sampled by gill nets in 2003 (Table 20). The mean age of 1.9 years is within the range of the five-year period (Table 20). The 1999, 2000 and 2002 year classes comprise a majority of the current adult sauger population, with indications that 2003 was a fair reproductive year. Annual sauger survival for the 2002-2003 pooled data increased to 34% (Table 14). Sauger PSD for the 2003 sample, at 51, was the lowest value of the five-year period and was related to good recruitment of the 2002 and 2003 year classes of sauger (Table 16).

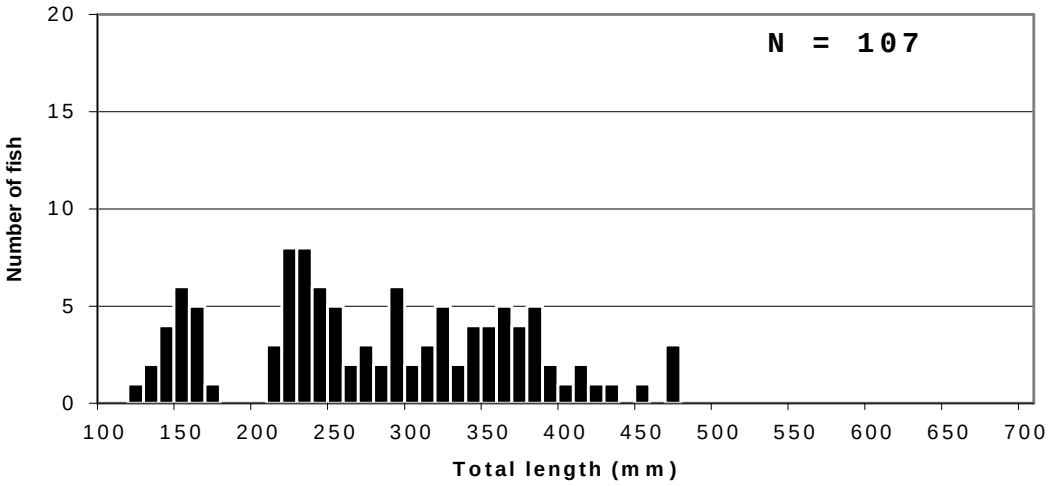


Figure 6. Length frequency of sauger collected with gill nets from Lake Francis Case, 2003. N = sample size.

Table 18. Mean annual growth increments (mm) of back-calculated total lengths for each year class of sauger collected with variable-mesh gill nets during September 2003 from Lake Francis Case. N = sample size.

Year class	Age	N	Growth increment at age			
			1	2	3	4
2002	1	46	189			
2001	2	14	160	140		
2000	3	20	178	103	58	
1999	4	8	186	90	75	56
All classes			178	108	59	62
N		88	88	42	28	8

Table 19. Mean back-calculated total lengths (mm) for each year class of sauger collected with variable-mesh gill nets during September 2003 from Lake Francis Case. N = sample size.

Year class	Age	N	Back-calculated length at age			
			1	2	3	4
2002	1	46	189			
2001	2	14	160	300		
2000	3	20	178	281	339	
1999	4	8	186	276	351	407
All classes			178	286	345	407
N		88	88	42	28	8

Table 20. Age distribution of sauger collected from Lake Francis Case with variable-mesh gill nets, 1999-2003. Mean age excludes age-0 fish.

Year	Age							
	0	1	2	3	4	5	6	Mean
1999	19	53	28	29	6	0	1	1.9
2000	3	66	48	17	14	1	0	1.9
2001	4	53	56	18	0	1	0	1.8
2002	49	37	58	20	2	1	0	1.9
2003	5	46	14	20	8	0	0	1.9

Population Parameters for Smallmouth Bass

Smallmouth bass CPUE for the 2003 in gill net survey (Table 8) decreased from that calculated for 2002 but remained above the 5-year average. Smallmouth bass CPUE in 2003 electrofishing samples (Table 7), with the exception of the Fort Randall Dam sampling station, increased over 2002 values. The increase in smallmouth bass CPUE's, while not statistically significant, suggests that smallmouth bass abundance may be on the increase after several years of low recruitment (Stone and Sorensen 2000, 2001, 2002, 2003). Annual growth increments and back-calculated lengths of smallmouth bass from LFC during 2002 (the last full year that growth could be calculated) are presented in Tables 21 and 22. Small sample size prevents meaningful growth comparisons with previous year's data from being made. Smallmouth bass condition remains excellent, as W_r values for all length categories sampled were above 100 (Table 15).

Table 21. Mean annual increments (mm) of back-calculated total lengths for each year class of smallmouth bass collected with variable-mesh gill nets during September 2003 from Lake Francis Case. N = sample size.

Year class	Age	N	Growth increment at age	
			1	2
2002	1	13	102	
2001	2	7	85	138
All classes			97	118
N		20	20	7

Table 22. Mean back-calculated total lengths (mm) for each year class of smallmouth bass collected with variable-mesh gill nets during September 2003 from Lake Francis Case. N = sample size.

Year class	Age	N	Back-calculated length at age	
			1	2
2002	1	13	102	
2001	2	7	85	223
All classes			94	223
N		20	20	7

Two year classes were represented in the 2003 gill net sample, with a mean age of 1.4 years (Table 23). Smallmouth bass PSD for the gill net sample decreased to 25 (Table 16), reflective of the gill net sample being comprised of mostly age-1 fish. Annual survival, for pooled 2002 and 2003 gill net data, was 45 percent (Table 14). Lengths of fish sampled by spring electrofishing ranged from 60 mm to 460 mm TL, while those collected by fall gill nets ranged from 90 mm to 320 mm TL (Figure 7).

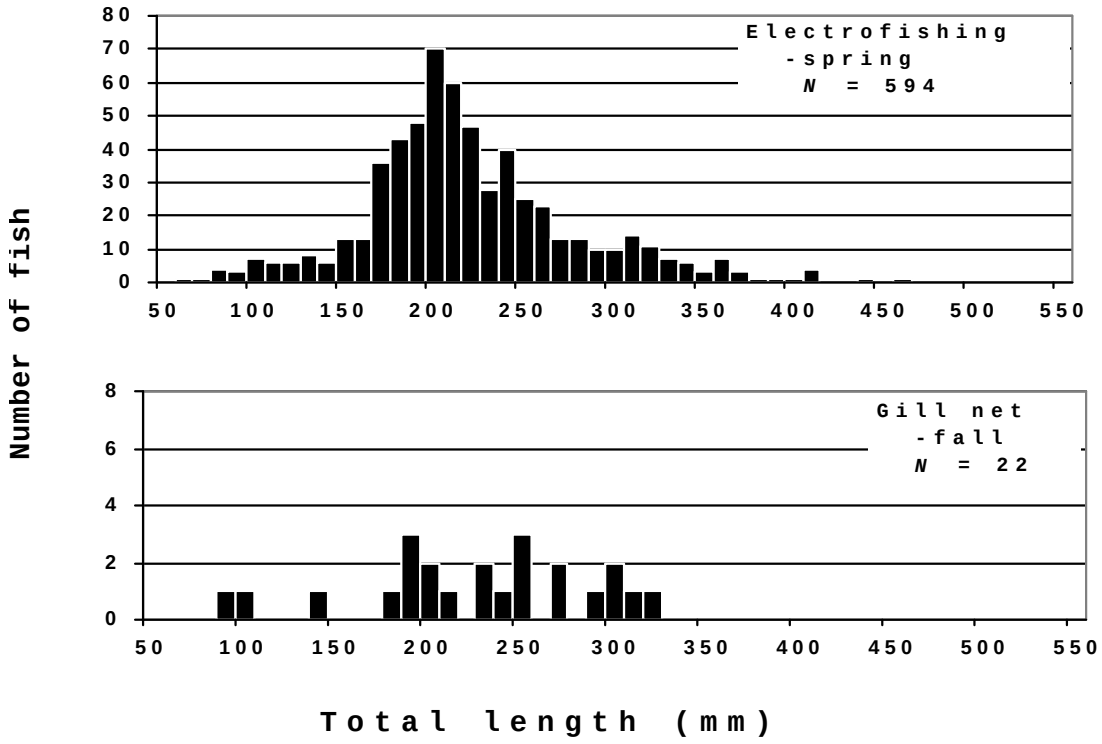


Figure 7. Length frequencies of smallmouth bass collected by spring electrofishing and fall gill netting from Lake Francis Case, 2003. *N* = sample size

Table 23. Age distribution of smallmouth bass collected from Lake Francis Case with variable-mesh gill nets, 1999-2003. Mean age excludes age-0 fish.

	Age							
Year	0	1	2	3	4	5	6	Mean
1999	1	9	5	0	0	0	0	1.4
2000	0	5	13	6	0	0	0	2.0
2001	0	4	4	3	1	0	0	2.1
2002	0	22	11	3	0	0	1	1.6
2003	0	13	7	0	0	0	0	1.4

Data on smallmouth bass tagged at five locations in LFC from 1999 to 2003 are presented in Table 24. During 2003, anglers returned (harvested fish) only 6.6% of the tags placed that spring, and an additional 0.7%, 0.4% and 1.3% of the 2002, 2001, and 1999 tags respectively (Table 24). No tags, that were placed in 2000, were returned by LFC anglers in 2003 (Table 24). Tag return percentages, by location tagged, for 2003 tagged fish that were harvested, ranged from a low of 4.9% at Chamberlain to a high of 11.8% for smallmouth bass tagged at Pease Creek (Table 24). As observed with fish tagged the previous four years (Stone and Sorensen 2000, 2001, 2002, 2003), most smallmouth bass were recaptured at, or very near to, their original tagging location. Only two of the 13 tagged smallmouth bass in 2003, that were reported as harvested, were recaptured farther than 4 river-miles from their release location. A bass that was tagged at Chamberlain was recaptured at Big Bend Dam, a movement of approximately 18 river miles, while a bass that was tagged at Platte Creek was recaptured at Svatos Bay near North Point Recreation Area, a movement of approximately 29 river miles. In addition to the smallmouth bass being reported as harvested, an additional 2.0% of the 2002 tagged fish and 7.7% of the 2003 tagged fish were reported as being caught and released at least one time during 2003.

Table 24. Number of smallmouth bass tagged, by location, and angler tag returns (number and percent of total number tagged), from harvested fish, Lake Francis Case, 1999–2003.

Tagging Locations	Number tagged	Tags returned											
		Year returned										Cumulative	
		1999		2000		2001		2002		2003			
1999 tags		**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Chamberlain	60	7	11.7	0	0.0	0	0.0	0	0.0	0	0.0	7	11.7
Snake Creek	16	1	6.3	0	0.0	0	0.0	0	0.0	1	6.3	2	12.5
Platte Creek	54	6	11.1	2	3.7	0	0.0	0	0.0	2	3.7	10	18.5
Pease Creek	43	3	7.0	0	0.0	0	0.0	0	0.0	0	0.0	3	7.0
Ft. Randall Dam	53	4	7.5	0	0.0	0	0.0	0	0.0	0	0.0	4	7.5
Total	226	21	9.3	2	0.9	0	0.0	0	0.0	3	1.3	26	11.5
2000 tags													
Chamberlain	56			2	3.6	1	1.8	0	0.0	0	0.0	3	5.4
Snake Creek	21			1	4.8	2	9.5	0	0.0	0	0.0	3	14.3
Platte Creek	43			0	0.0	1	2.3	0	0.0	0	0.0	1	2.3
Pease Creek	40			3	7.5	0	0.0	0	0.0	0	0.0	3	7.5
Ft. Randall Dam	45			0	0.0	2	4.5	0	0.0	0	0.0	2	4.5
Total	205			6	2.9	6	2.9	0	0.0	0	0.0	12	5.8
2001 tags													
Big Bend Dam	36					3	8.3	2	5.6	0	0.0	5	13.9
Chamberlain	40					4	10.0	1	2.5	0	0.0	5	12.5
Platte Creek	40					6	15.0	1	2.5	0	0.0	7	17.5
Pease Creek	50					4	8.0	0	0.0	0	0.0	4	8.0
Ft. Randall Dam	64					5	7.8	0	0.0	1	1.6	6	9.4
Total	230					22	9.6	4	1.7	1	0.4	27	11.7
2002 tags													
Big Bend Dam	32							1	3.1	0	0.0	1	3.1
Chamberlain	58							2	3.4	0	0.0	2	3.4
Platte Creek	9							0	0.0	0	0.0	0	0.0
Pease Creek	17							3	17.6	0	0.0	3	17.6
Ft. Randall Dam	34							1	2.9	1	2.9	2	5.9
Total	150							7	4.7	1	0.7	8	5.3
2003 tags													
Big Bend Dam	58									3	5.2	3	5.2
Chamberlain	41									2	4.9	2	4.9
Platte Creek	30									3	10.0	3	10.0
Pease Creek	17									2	11.8	2	11.8
Ft. Randall Dam	50									3	6.0	3	6.0
Total	196									13	6.6	13	6.6

Table 25 provides 2003 LFC smallmouth bass tagging and recapture statistics, by length group. The low sample size makes it difficult to draw conclusions from this data.

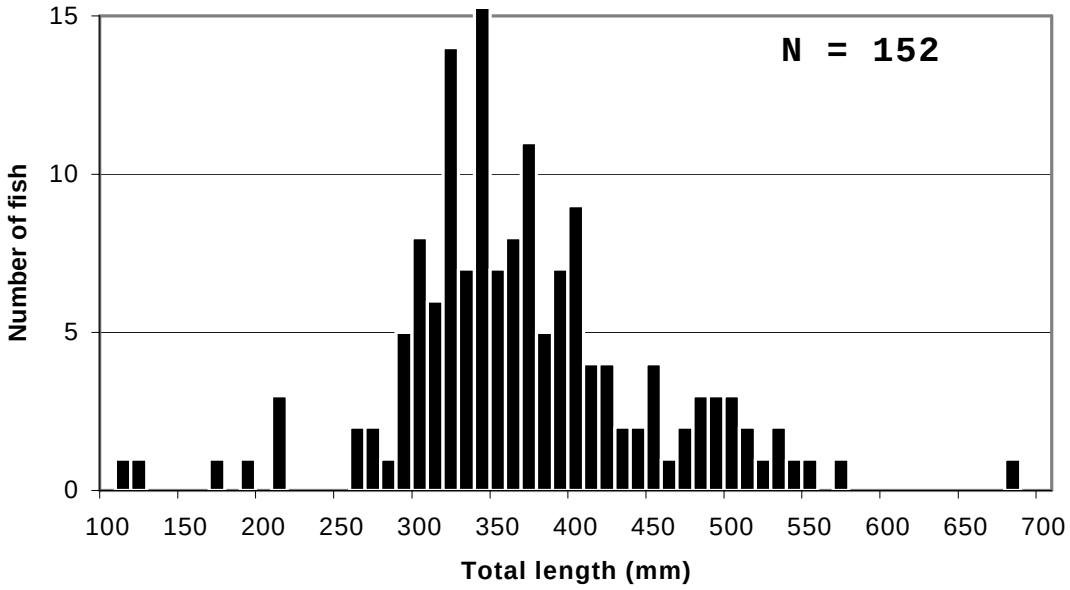
Table 25. Smallmouth bass tagging and recapture statistics, by length group, for fish tagged during 2003 in Lake Francis Case.

Length Group (mm)	Number Tagged	Number			Percent Caught	Percent of those caught	
		Caught	Kept	Released		Kept	Released
250-299	94	7	1	6	7.4	14	86
300-349	70	13	6	7	18.6	46	54
350-399	22	5	4	1	22.7	80	20
400-449	8	1	0	1	12.5	0	100
450-499	2	2	2	0	100	100	0
Total	196	12	13	5	8.0	58	42

Population Parameters for Channel Catfish

Channel catfish gill net CPUE in 2003 (Table 8) was unchanged from 2002 and was the highest of the five-year period. Channel catfish ranging from 110 mm to 680 mm TL (Figure 8) were collected in the 2003 gill net survey. Channel catfish PSD, RSD and mean W_r values are presented in Appendix 5.

Figure 8. Length frequency of channel catfish collected with gill nets from Lake Francis Case, 2003. N = sample size.



Paddlefish Monitoring

Efforts to monitor the LFC paddlefish population were initiated on 21 May 2003. Collection efforts occurred over six days near the mouth of the White River, and resulted in 14 paddlefish being transported to American Creek Fisheries Station at Chamberlain for artificial propagation efforts. After spawning, all paddlefish were coded-wire-tagged (CWT) and released (Table 27).

Table 26. Statistics on paddlefish collected from Lake Francis Case, 2003. CWT = coded wire tag.

Fish number	Date tagged	Tagging/release location	Eye-fork length (mm)	Weight (kg)	Sex	Previous tag	
						Jaw (No.)	CWT (Y/N)
1	5/29/03	Chamberlain	1342	52.6	F	-	N
2	5/29/03	Chamberlain	1186	35.4	F	-	N
3	5/29/03	Chamberlain	1175	27.2	F	-	N
4	5/29/03	Chamberlain	1250	35.8	F	-	N
5	5/29/03	Chamberlain	915	13.1	M	-	Y
6	5/29/03	Chamberlain	970	14.2	M	-	N
7	5/29/03	Chamberlain	870	12.3	M	-	Y
8	5/29/03	Chamberlain	874	10.4	M	-	Y
9	5/29/03	Chamberlain	934	13.7	M	-	N
10	5/29/03	Chamberlain	690	4.4	M	-	Y
11	5/29/03	Chamberlain	1073	15.2	M	-	N
12	5/29/03	Chamberlain	892	10.0	M	-	Y
13	5/29/03	Chamberlain	820	8.4	M	-	Y
14	5/29/03	Chamberlain	904	10.6	M	-	Y

Water Temperature Monitoring

Figure 9 provides water temperature data for 2003. Water temperatures warmed rapidly, reaching 25 C by early July and approaching 27 C in several reservoir locations during mid-to-late July. Overall, the 2003 LFC water temperature profile was similar to the 2002 profile and warmer that those measured in other recent years (Stone 1997a, 1998; Stone and Sorensen 1999, 2000, 2003).

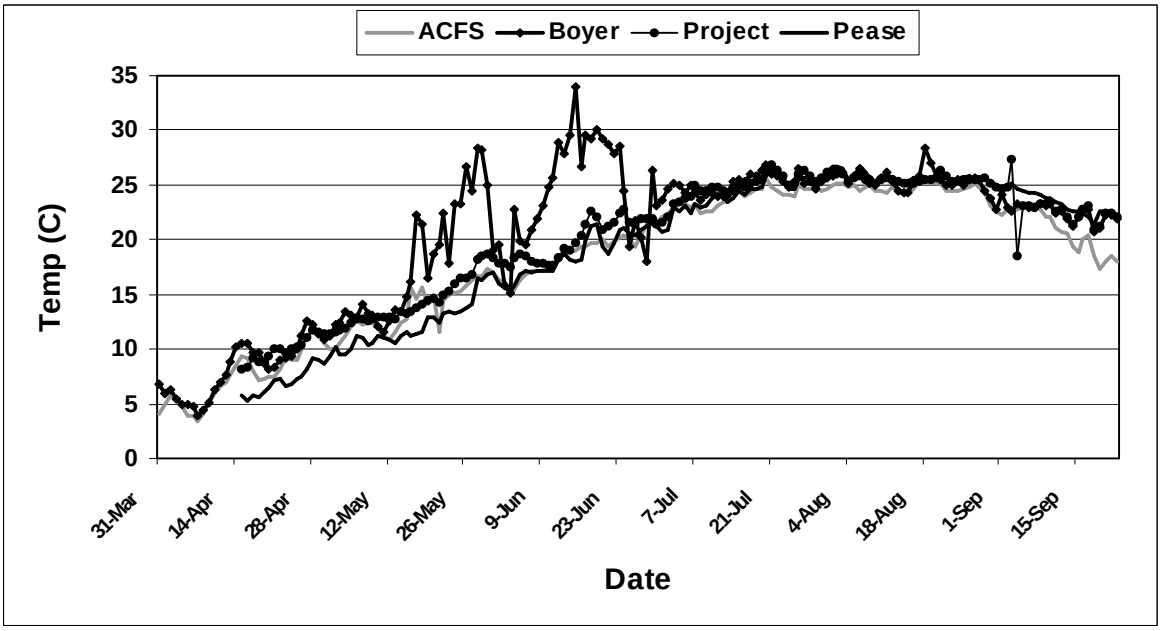


Figure 9. Water temperature in Lake Francis Case at four sampling locations: ACFS – American Creek Fisheries Station, Boyer, Project Bay, and Pease Creek, 2003.

ANGLER USE AND SPORT FISH HARVEST SURVEY

Fishing Pressure

Lake Francis Case anglers spent an estimated 710,078 hours (+/- 75,476 h, 95% CI) fishing during the April through September, 2003 creel survey period (Table 27). This estimate is very similar to the 714,510 hours estimated for the same period in 2002 (Table 1).

Table 27. Estimated total fishing pressure (angler hours), by month and zone, on Lake Francis Case, April-September 2003. (+/- 95% confidence interval)

Zone	Apr	May	Jun	Jul	Aug	Sep	Total
1 - upper	56,624 (23,507)	67,511 (25,110)	72,334 (19,749)	26,765 (8,926)	19,023 (5,322)	11,554 (3,754)	253,811 (41,173)
2 - middle	18,936 (22,437)	83,800 (33,858)	75,916 (25,484)	30,556 (7,616)	17,135 (9,208)	7,324 (3,107)	233,668 (49,514)
3 - lower	5,709 (3,043)	61,892 (61,056)	63,441 (10,389)	49,372 (12,651)	31,151 (7,853)	11,034 (7,142)	222,599 (39,366)
Total	81,269 (32,638)	213,202 (54,191)	211,692 (33,873)	106,693 (17,255)	67,310 (13,221)	29,912 (8,646)	710,078 (75,476)

Estimated fishing pressure averaged 20.1 angler-h/ha (Table 28). The middle portion of the reservoir (Figure 1) received the heaviest pressure at 25.5 angler-h/ha. The upper and lower portions of the reservoir received similar use at 17.3 and 19.4 angler-h/ha, respectively. Peak fishing pressure occurred in May and June, a typical LFC pattern (Figure 10).

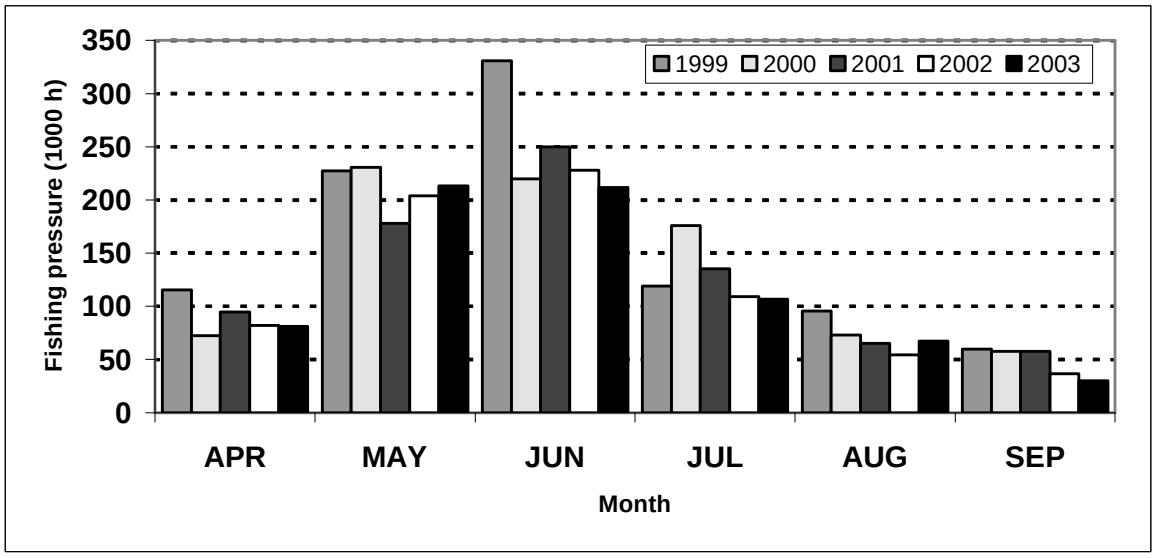


Figure 10. Estimated fishing pressure, by month, on Lake Francis Case, 1999-2003.

Table 28. Estimated total angler hours, for boat anglers, shore anglers, and angling methods combined, by zone, for Lake Francis Case, April-September, 2003.

	Boat			Shore			Combined		
Zone	Total angler hours	%	No. h/ha	Total angler hours	%	No. h/ha	Total Angler hours	%	No. h/ha
1 - upper	236,279	34	16.1	17,532	75	1.2	253,811	36	17.3
2 - middle	231,509	34	25.3	2,158	9	0.2	233,668	33	25.5
3 - lower	218,806	32	19.1	3,793	16	0.3	222,599	31	19.4
Tot/Avg	686,594	100	19.5	23,483	100	0.7	710,078	100	20.1

Fish Harvest

Anglers fishing LFC, during the April-September 2003 period, harvested an estimated 205,705 fish (+/- 27,542 fish, 95% CI); all species, fishing methods and zones combined, including an estimated walleye harvest of 162,581 fish (+/- 22,181 fish, 95% CI; Table 29). Fifteen species of fish were observed in the 2003 harvest, with walleye accounting for 79% of the total number harvested (Table 29). Channel catfish, white bass, and sauger accounted for 6.7, 5.4 and 4.4% of the 2003 estimated total harvest, respectively. The harvest estimate for walleye decreased from 2002 to 2003, while the harvest estimate for sauger increased from 2002 to 2003 (Stone and Sorensen 2003). The decrease in walleye harvest from 2002 to 2003, could be attributed to several factors including lower population abundance, declining May water levels, and a large shad hatch. Sauger harvest, at 9,057 fish, remained above the ten-year average of 5,893 and can be attributed to high recruitment of the 1999, 2000 and 2002 year-classes. Increases in estimated harvest from 2002 (Stone and Sorensen 2003) to 2003 were noted for most species including white bass, smallmouth bass and northern pike. White bass abundance and harvest continued to rebound since a large die-off of the adult population occurred in 1998 (Stone and Sorensen 1999). High recruitment of the 2001 and 2002 white bass year-classes (Stone and Sorensen 2002, 2003) contributed to an increase in the 2003 white bass harvest. An increase in smallmouth bass harvest from 2002 (Stone and Sorensen 2003) to 2003 reflects an increase in bass abundance during 2002 and 2003 from previous years (Stone and Sorensen 2003, this survey). Moderate recruitment in 2002 (Stone and Sorensen 2003) and 2003 suggest that smallmouth bass harvest may increase in future years.

Table 29. Estimated total fish harvest, by month, for anglers fishing Lake Francis Case, April-September, 2003. (+/- 95% confidence interval)

Month	WAE	SAR	SMB	CCF	WHB	NOP	YEP	OTH*	Total
April	18,207 (7,062)	1,403 (944)	187 (201)	1,088 (1,082)	264 (370)	114 (116)	56 (94)	186 (293)	21,504 (8,640)
May	60,835 (17,109)	3,982 (3,511)	1,923 (727)	812 (536)	1,493 (1,447)	127 (176)	59 (135)	765 (1,538)	69,995 (20,206)
June	41,692 (8,572)	2,491 (1,537)	2,297 (1,449)	3,482 (1,401)	3,553 (2,188)	82 (108)	85 (149)	707 (912)	54,389 (11,097)
July	30,174 (7,990)	828 (569)	513 (255)	3,061 (1,213)	4,060 (3,298)	64 (74)	206 (320)	482 (492)	39,387 (11,036)
August	9,064 (3,186)	324 (299)	594 (470)	2,950 (1,367)	837 (810)	0 (-)	0 (-)	34 (70)	13,804 (3,982)
September	2,609 (1,395)	29 (36)	719 (646)	2,293 (3,305)	902 (626)	9 (14)	51 (70)	13 (24)	6,625 (3,854)
Total	162,581 (22,181)	9,057 (4,000)	6,232 (1,836)	13,686 (4,205)	11,109 (4,352)	396 (248)	458 (396)	2,188 (2,354)	205,705 (27,542)

*OTH includes black crappie, common carp, flathead catfish, freshwater drum, goldeye, rainbow trout, shorthead redhorse and white crappie.

Estimated fish harvest during 2003, by survey zone (see Figure 1 for zone identification), followed a typical LFC pattern (Stone 1995; Stone et al. 1994; Stone and Wickstrom 1992). Anglers who fished the upper portion of the reservoir accounted for 42 percent of the harvest, followed by the middle and lower zones each with 29 percent of the harvest (Table 30). Walleye, sauger, channel catfish, and white bass harvest in 2003 was highest in the upper zone, while most smallmouth bass were harvested in the lower zone of the reservoir (Table 30).

Table 30. Estimated total fish harvest, by zone, for anglers fishing Lake Francis Case, April-September, 2003. (+/- 95% confidence interval)

Zone	WAE	SAR	SMB	CCF	WHB	NOP	YEP	OTH*	Total
1 - upper	66,189 (14,928)	5,580 (3,771)	1,158 (1,169)	6,083 (1,814)	6,647 (4,132)	228 (209)	181 (188)	190 (394)	86,256 (19,660)
2 - middle	49,874 (12,058)	2,723 (1,262)	1,911 (616)	2,518 (1,332)	2,441 (902)	94 (87)	27 (44)	1,004 (1,084)	60,592 (14,163)
3 - lower	46,518 (11,125)	753 (426)	3,163 (1,275)	5,084 (3,552)	2,020 (1,026)	74 (103)	250 (345)	994 (1,528)	58,857 (13,094)
Total	162,581 (22,181)	9,057 (4,000)	6,232 (1,836)	13,686 (4,205)	11,109 (4,352)	396 (248)	458 (396)	2,188 (2,354)	205,705 (27,542)

*OTH includes black crappie, common carp, flathead catfish, freshwater drum, goldeye, rainbow trout, shorthead redhorse and white crappie.

Estimated total fish harvest (Table 29), as well as walleye harvest (Figure 11), peaked in May during 2003, atypical of the normal LFC pattern, where pressure and harvest peak in June (Stone 1995; Stone et al. 1994). Changes in walleye harvest regulations, initiated in 1990 and modified for 1999, continue to maintain the walleye size structure at a level that allows an ample number of legal-sized fish to be available for harvest during the period of the year that size limit regulations are in effect.

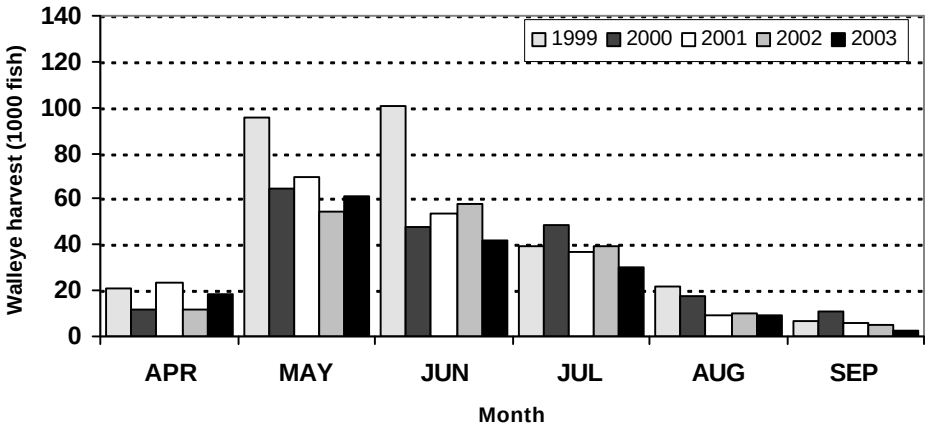


Figure 11. Estimated total walleye harvest, by month, for anglers fishing Lake Francis Case, 1999-2003.

Monthly length frequencies of angler-caught walleye (Figure 12), reflect the impact of the September-June 381-mm (15 inch) minimum-length limit. During April through June and September of 2003, very few walleye under 381 mm were harvested (illegal), while in July and August, fish under 381 mm were common in the walleye harvest. However, mean size of walleye harvested, by month, remained near or above the 381 mm (minimum length limit) during all months (Figure 12). Overall, mean length of walleye harvested by sport anglers has been considerably higher since the 1990 changes in walleye sport fishing regulations were implemented (Table 1). Table 31 provides statistics on the percentage of angling parties that caught a daily limit of walleye/sauger. The percentage of angling parties harvesting a limit was 8% in 2003, similar to the previous three years.

Monthly length frequencies, of angler-caught smallmouth bass are presented in Figure 13

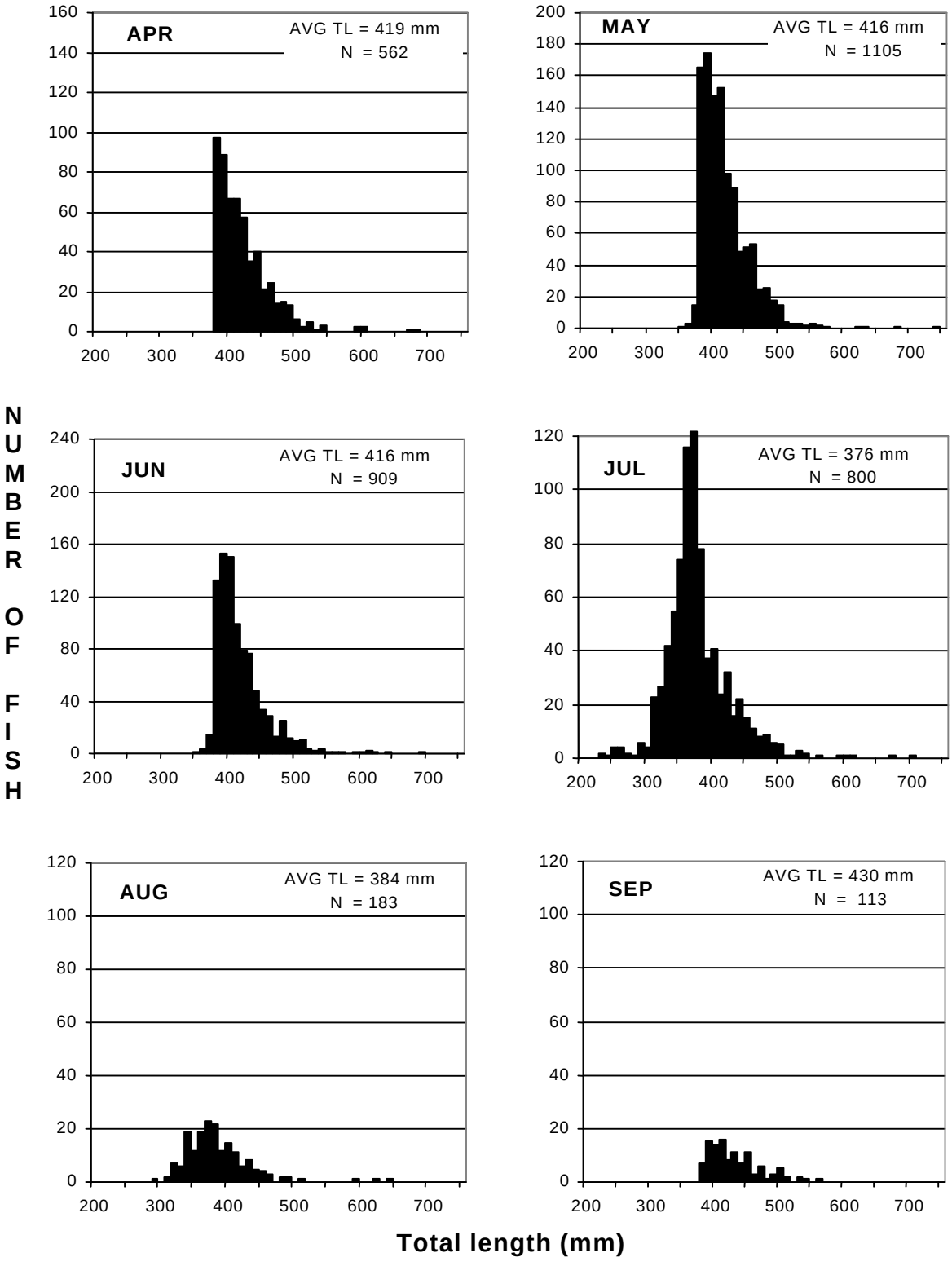


Figure 12. Monthly length frequencies of angler-caught walleye from Lake Francis Case, 2003. N = sample size.

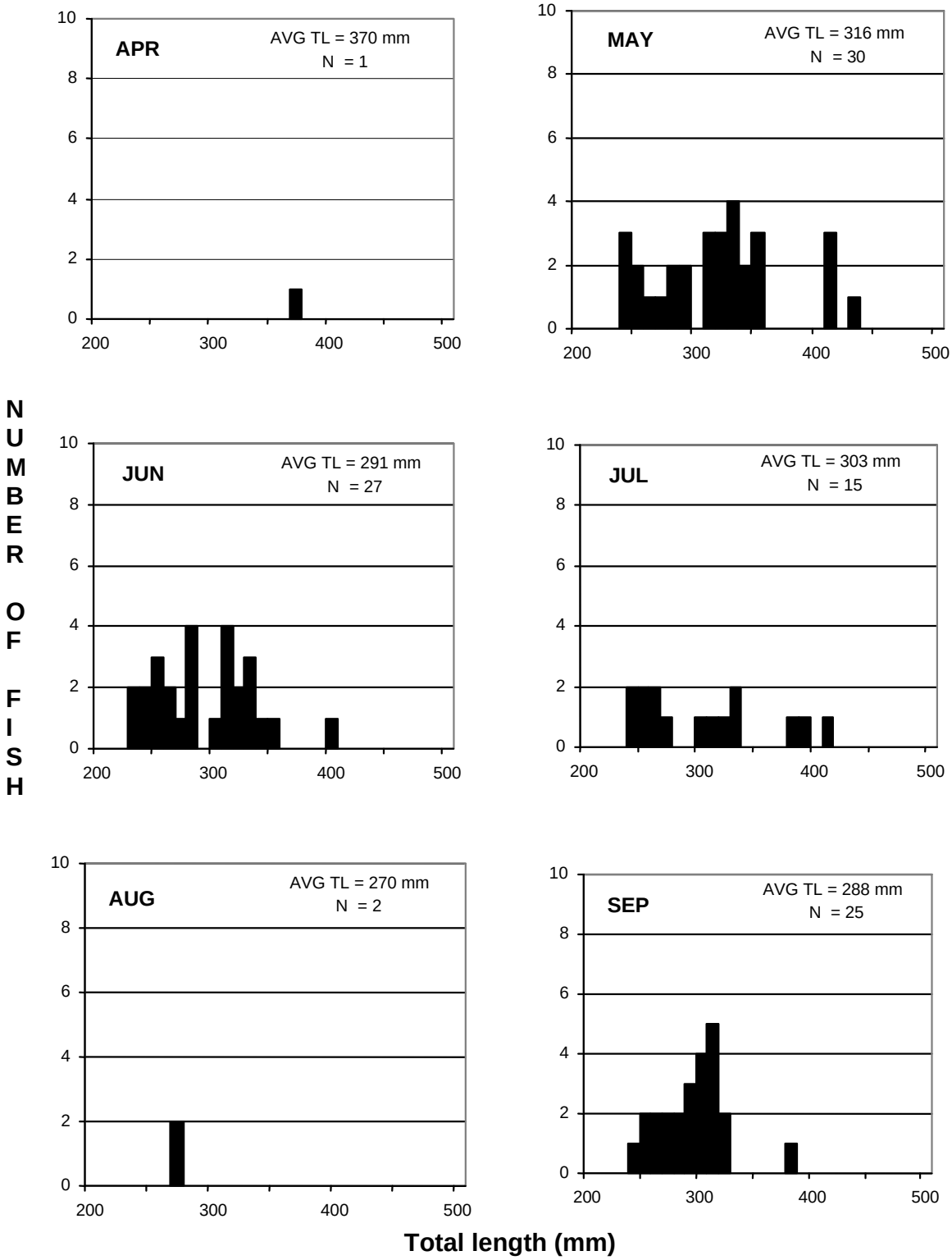


Figure 13. Monthly length frequencies of angler-caught smallmouth bass from Lake Francis Case, 2003. N = sample size.

Table 31. Percent of angling parties harvesting a limit of walleye-sauger/angler, at least three walleye-sauger/angler, at least two walleye-sauger/angler, etc. from Lake Francis Case, 1999-2003.

Party success walleye-sauger/angler	1999	2000	2001	2002	2003
Limit (4)	15	8	8	8	8
3.0 - 3.9	7	9	6	6	6
2.0 - 2.9	13	12	10	10	10
1.0 - 1.9	18	19	18	18	19
0.1 - 0.9	15	15	16	16	17
0	32	37	42	42	38

Fish Caught and Released

Catch and release, either mandated by length-limit regulations or voluntary, has become an important component of the LFC sport fishery. Table 32 presents estimates of the number of fish released by month. For each species listed in Table 32, the number of fish estimated to have been caught and released exceeded harvest estimates, with the exception of northern pike (Table 29). While the estimate of released fish is based on the angler's ability to recall what they released and may be biased up or down, it does provide trend data and gives a good indication of the magnitude of fish being released. The overall number of fish estimated to have been released, by LFC anglers in 2003, increased from the 2002 estimate (Stone and Sorensen 2003).

Table 32. Estimated number of fish caught and released, by month, for anglers fishing Lake Francis Case, 2003.

Month	WAE	SAR	SMB	CCF	WHB	NOP	YEP	OTH*	Total
April	21,191	241	278	721	858	53	46	244	23,632
May	155,757	2,481	6,748	2,312	8,429	74	67	3,607	179,474
June	241,938	17,110	17,403	5,801	14,563	52	231	7,958	305,054
July	39,948	3,157	4,784	5,554	5,595	0	720	9,872	69,631
August	5,915	114	1,970	7,770	1,772	16	258	4,931	22,745
September	5,087	170	1,501	776	534	13	165	1,375	9,621
Total	469,837	23,272	32,684	22,934	31,750	207	1,489	27,986	610,158

* OTH includes black crappie, bigmouth buffalo, bluegill, common carp, flathead catfish, freshwater drum, goldeye, largemouth bass, rainbow trout, shortnose gar, shovelnose sturgeon, smallmouth buffalo, and white crappie.

Harvest, Release and Catch Rates

Mean harvest rate (species, type of fishing, and zones combined) for LFC, during 2003, was 0.29 fish/angler-h (Table 33), within the range observed during previous surveys (Table 1). An excellent overall catch rate (the 2003 harvest rate plus estimated release rate of 0.86 fish/angler-h) of 1.15 fish/angler-hour was estimated for the April through September 2003 daylight period (Table 34). Mean catch rates were highest during May and June while the mean harvest rate was highest during July (Table 34).

The mean walleye harvest rate was 0.23 walleye/angler-h (Table 35) for the April–September daytime period. When harvest rate for walleye was combined with release rate, an excellent overall catch rate of 0.89 walleye/angler-h was estimated (Table 35). This value is more than double the rate of 0.30 fish/angler-h that is considered by most biologists to be indicative of an excellent walleye fishery (Colby et al. 1979).

Catch and harvest rates for smallmouth bass, during 2003, are presented in Table 36. While the 2003 smallmouth bass harvest rate was similar to 2002 estimate (Stone and Sorensen 2003), the increase in the 2003 estimated release rate over that estimated for 2002 (Stone and Sorensen 2003) resulted in an increase in the overall catch rate in 2003.

Table 33. Estimated harvest rate, release, rate and catch rate, by species (+/- 95% confidence interval), for anglers fishing Lake Francis Case, 2003.

Species	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)	Catch rate (fish/angler-h)
Walleye	0.229 (0.056)	0.662 (0.174)	0.891 (0.223)
Sauger	0.013 (0.007)	0.033 (0.018)	0.046 (0.023)
Smallmouth bass	0.009 (0.004)	0.046 (0.013)	0.055 (0.016)
Channel catfish	0.019 (0.008)	0.032 (0.008)	0.052 (0.014)
White bass	0.016 (0.007)	0.045 (0.017)	0.060 (0.021)
Northern pike	0.001 (-)	0.000 (-)	0.001 (0.001)
Yellow perch	0.001 (0.001)	0.002 (0.001)	0.003 (0.001)
Other*	0.002 (-)	0.039 (-)	0.041 (-)
Species combined	0.290 (0.071)	0.859 (0.212)	1.149 (0.275)

* Other includes black crappie, bigmouth buffalo, bluegill, common carp, flathead catfish, freshwater drum, goldeye, largemouth bass, rainbow trout, shorthead redhorse, shortnose gar, shovelnose sturgeon, smallmouth buffalo, and white crappie.

Table 34. Estimated harvest rate, release rate, and catch rate for all species combined (+/- 95% confidence interval), by month, for anglers fishing Lake Francis Case, 2003.

Month	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)	Catch rate (fish/angler-h)
April	0.265 (0.197)	0.291 (0.224)	0.555 (0.417)
May	0.328 (0.188)	0.842 (0.459)	1.170 (0.638)
June	0.257 (0.089)	1.441 (0.566)	1.698 (0.647)
July	0.369 (0.168)	0.653 (0.256)	1.022 (0.416)
August	0.205 (0.092)	0.338 (0.134)	0.543 (0.212)
September	0.222 (0.262)	0.322 (0.222)	0.543 (0.487)
Combined	0.290 (0.071)	0.859 (0.212)	1.149 (0.275)

Table 35. Estimated harvest rate, release rate, and catch rate of walleye (+/- 95% confidence interval), by month, for anglers fishing Lake Francis Case, 2003.

Month	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)	Catch rate (fish/angler-h)
April	0.224 (0.166)	0.261 (0.204)	0.485 (0.368)
May	0.285 (0.160)	0.731 (0.400)	1.016 (0.551)
June	0.197 (0.069)	1.143 (0.468)	1.340 (0.529)
July	0.283 (0.126)	0.374 (0.173)	0.657 (0.295)
August	0.135 (0.064)	0.088 (0.041)	0.223 (0.095)
September	0.087 (0.083)	0.170 (0.141)	0.257 (0.223)
Combined	0.229 (0.056)	0.662 (0.174)	0.891 (0.223)

Table 36. Estimated harvest rate, release rate, and catch rate of smallmouth bass (+/- 95% confidence interval), by month, for anglers fishing Lake Francis Case, 2003.

Month	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)	Catch rate (fish/angler-h)
April	0.002 (0.003)	0.003 (0.005)	0.006 (0.007)
May	0.009 (0.006)	0.032 (0.021)	0.041 (0.026)
June	0.012 (0.010)	0.082 (0.027)	0.093 (0.037)
July	0.005 (0.003)	0.045 (0.045)	0.050 (0.048)
August	0.009 (0.008)	0.029 (0.024)	0.038 (0.029)
September	0.024 (0.020)	0.050 (0.042)	0.074 (0.053)
Combined	0.009 (0.004)	0.046 (0.013)	0.055 (0.016)

Angler Demographics and Economics

Thirty seven percent of anglers contacted on LFC during 2003 were non-residents, similar to the values measured the previous five years (Stone and Sorensen 1999, 2000, 2001, 2002, 2003). Non-resident anglers from 17 states were contacted, during 2003, (Table 37) with Iowa, Nebraska and Minnesota anglers accounting for the majority of non-resident angler contacts. Figure 14 provides information on the county of residence of South Dakota anglers who fished LFC in 2003. Over 86% of the resident LFC anglers came from counties in the southeastern ¼ of the state (Figure 14).

Table 37. Percentage of non-resident anglers who fished Lake Francis Case, 1999-2003, by state of residence, expressed as percent of total non-residents.

State	1999	2000	2001	2002	2003
Iowa	40.0	42.2	42.9	42.4	46.0
Nebraska	37.1	38.1	38.6	36.6	39.5
Minnesota	16.7	11.3	10.3	14.0	9.1
Colorado	0.9	1.3	0.8	1.3	1.6
Wisconsin	0.5	0.6	1.4	1.3	0.3
Kansas	0.4	-	0.5	0.8	0.3
Missouri	0.4	1.3	1.4	0.8	1.2
Illinois	0.2	0.9	0.4	0.3	0.2
North Dakota	0.7	0.4	0.7	0.3	0.3
Florida	0.5	0.6	0.3	0.2	0.5
Montana	0.4	0.2	0.3	0.2	-
Wyoming	0.1	0.1	0.8	0.2	0.2
California	0.4	0.6	0.4	-	0.3
Other*	-	2.2	1.2	1.6	0.5

*Other includes: Arkansas, Michigan, Oregon, Tennessee and Texas

Mean angler trip length (boat and shore combined) on LFC was 5.1 hours (Table 1), for the April-September, 2003 daylight period. The average angling party consisted of approximately 2.3 individuals. Anglers traveling at least 100 miles (one-way), to fish LFC, accounted for about 65 percent of all trips (Table 38). Table 39 provides information on the target species of Lake Francis Case anglers in 2003.

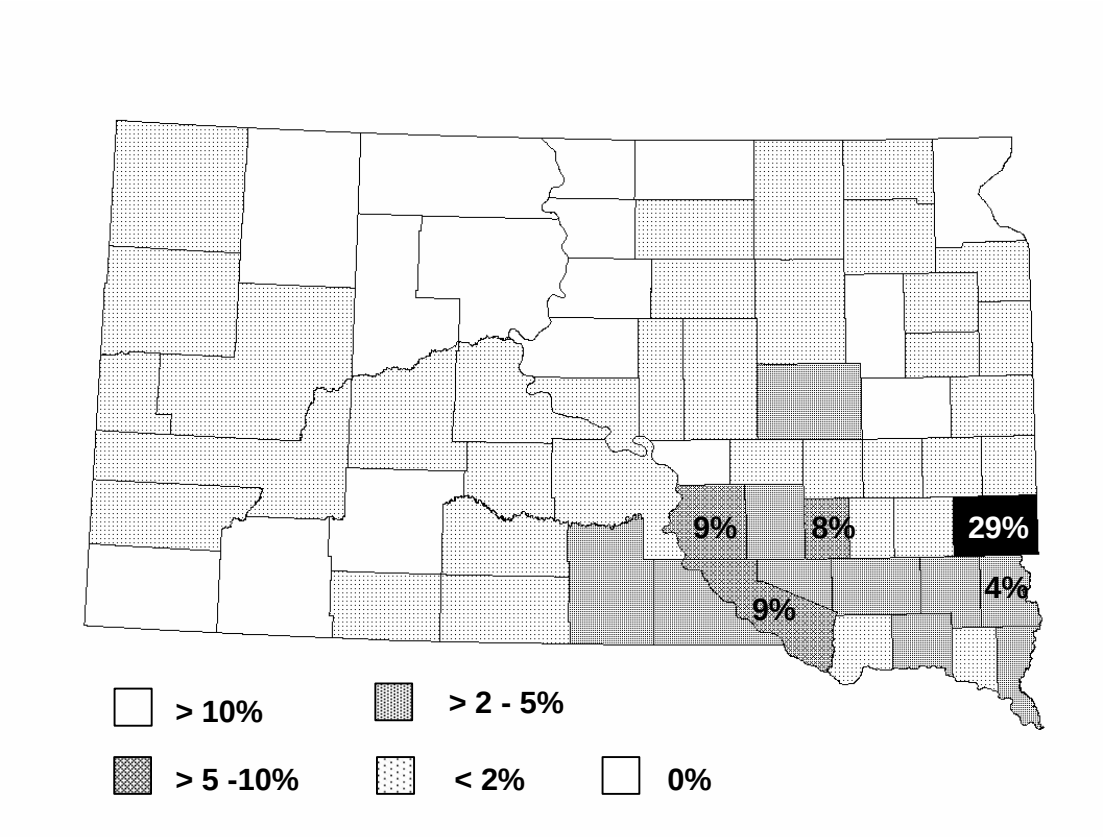


Figure 14. County of residence for 2003 Lake Francis Case anglers. Percentage of total resident anglers is shown for the top five represented counties.

The 2003 LFC fishery had an estimated economic impact of nearly 8.3 million dollars to local economies, based on approximately 139,000 angling trips. This estimate is based on an average expenditure of $60/trip for angling in South Dakota (U.S. Dept. of Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Bureau of Census 2002).

Table 38. Percentage of anglers traveling specified distances, one way, to fish Lake Francis Case during 1999-2003.

Distance (miles)	1999	2000	2001	2002	2003
<25	11.3	13.7	10.7	12.1	11.2
25-50	6.8	7.2	17.4	17.8	7.6
51-100	18.4	17.4	19.3	13.4	15.9
101-200	44.1	39.8	37.1	38.7	43.1
200+	19.4	21.8	15.5	18.0	22.2

Table 39. Target species of Lake Francis Case anglers, during 1999-2003, expressed as percentage of total angling trips.

Target species	1999	2000	2001	2002	2003
Walleye	93.2	93.4	97.0	93.5	94.6
Anything	3.1	4.1	0.2	3.8	3.6
Smallmouth bass	1.7	1.9	1.6	1.7	1.2
Other	2.0	0.6	1.2	1.0	0.6

ANGLER PREFERENCE AND ATTITUDE SURVEY

Angler attitudes about fishing and their preferences concerning management options are important components of a total fishery. Historically, fisheries biologists have primarily focused efforts on understanding biological aspects of fish populations and monitoring sport fish harvest and use. Recently, biologists have realized the necessity and value of understanding angler attitudes, level of satisfaction, and preferences. Consequently, more attitude, preference and satisfaction data has been collected in recent years.

The following results build on angler preference and attitude survey data collected previously from Lake Francis Case (Stone et.al. 1993; Stone 1997a, 1998; Stone and Sorensen 1999, 2000, 2001, 2002, 2003).

Angling Trip Satisfaction

How anglers feel about their fishing experience is important when evaluating the success of fishery management efforts. Angler responses help evaluate if current management practices and regulations are providing a fishery that meets angler needs and expectations. Table 40 provides angler responses on how satisfied, based on all factors, they were with their days fishing trip. Overall, 83% of LFC anglers expressed some degree of satisfaction with their days fishing versus approximately 12% who expressed some degree of dissatisfaction (Table 40). The 83% satisfaction rating falls within the range of previous surveys (Stone and Sorensen 2001, 2002, 2003) and exceeds the Missouri River Fisheries Program management objective of 70 percent (SDGFP 1997, unpublished document).

Table 40. Response of 2003 Lake Francis Case anglers, by month, to the question: "Considering all factors, how satisfied are you with your fishing trip today?" 1 = Very Satisfied, 2 = Moderately satisfied, 3 = Slightly satisfied, 4 = Neutral, 5 = Slightly dissatisfied, 6 = Moderately dissatisfied, 7 = Very dissatisfied, N.O. = No opinion. Median excludes those with no opinion.

	Satisfied →			Neut.	← Dissatisfied					
Month	1	2	3	4	5	6	7	N.O.	Total	Median
Apr	54	118	77	12	21	9	5	4	300	2
May	91	174	95	8	18	10	6	7	409	2
Jun	81	204	102	16	32	15	10	11	471	2
Jul	36	132	89	8	20	12	4	1	302	2
Aug	32	65	71	1	13	10	6	4	202	3
Sep	27	67	34	14	6	12	11	9	180	2
Total	321	760	468	59	110	68	42	36	1,864	2
Percent	17.2	40.8	25.1	3.2	5.9	3.6	2.3	1.9	100	-
Combined	83.1			3.2	11.8			1.9	100	-

Table 41 presents angler satisfaction, based on the number of walleye harvested per angler. These results follow the pattern documented in previous surveys (Stone 1997a, 1998; Stone and Sorensen 1999, 2000, 2001, 2002, 2003) showing a decrease in satisfaction and a corresponding increase in dissatisfaction as the number of walleye harvested per angler decreases. However, nearly 74% of the anglers who did not harvest a walleye still indicated that they were satisfied with their fishing trip. These results would follow the suggestion of other studies (Mendelsohn 1994, McPhillips 1989, Kinman and Hoyt 1984) that harvesting fish ranked below other components of a successful fishing trip (i.e. fun, relaxation, etc.). While these results do indicate a relationship between number of walleye harvested and trip satisfaction, they should not be interpreted as a direct relationship, other factors, such as weather or angler type (Gigliotti 1996) may affect catch and harvest rates, and in turn, influence the question response.

Table 41. Responses of 2003 Lake Francis Case anglers to the question: "Considering all factors, how satisfied are you with your fishing trip today?" by number of walleye harvested. Responses are grouped as satisfied, dissatisfied and neutral/no-opinion based on the more detailed breakdowns defined in Table 40.

No. walleye harvested/ angler	Satisfied		Dissatisfied		Neutral/No-Opinion	
	No.	Percent	No.	Percent	No.	Percent
4	105	95.5	1	0.9	4	3.6
3 – 3.9	118	94.4	6	4.8	1	0.8
2 – 2.9	187	94.9	4	2.0	6	3.1
1 – 1.9	329	91.1	24	6.6	8	2.2
0.1 – 0.9	266	79.9	53	15.9	14	4.2
0	543	73.7	132	17.9	62	8.4
Total	1,548	83.1	220	11.8	95	5.1

Table 42 provides angler responses to how they rated their days fishing based primarily on the numbers and sizes of fish they expected to catch. Overall, LFC anglers tended to rate their trips, based on the numbers of fish caught or sizes caught, as poor or very poor. As discussed above regarding trip satisfaction, factors other that catching and harvesting fish may influence how anglers rate their trip as well. Median trip rating based on numbers caught was highest in May, June and July, corresponding to the months when overall and walleye catch rates (Tables 34 and 35) were highest. However, despite the

fact that catch rates during these months were at or exceeded one fish per hour, the median trip rating based on numbers of fish caught was only in the "fair" category.

Table 42. Responses of 2003 Lake Francis Case anglers, by month, to the questions: "How would you rate your fishing today in terms of catching the numbers of fish you were expecting, or …the sizes of fish you were expecting?" 1 = Excellent, 2 = Good, 3 = Fair, 4 = Poor, 5 = Very poor, N.O. = No opinion. Median excludes no opinion responses.

	Numbers caught							
	Excel. →		Fair	← Poor				
Month	1	2	3	4	5	N.O.	Total	Median
Apr	9	20	32	54	33	4	152	4
May	26	64	56	58	23	7	234	3
Jun	20	69	52	53	21	5	220	3
Jul	10	41	52	52	28	4	187	3
Aug	3	15	9	32	22	1	82	4
Sep	3	5	14	20	35	3	80	4
Total	71	214	215	269	162	24	955	3
Percent	7.4	22.4	22.5	28.2	17.0	2.5	100	-
Combined	29.8		22.5	45.1		2.5	100	-
Month	**Sizes caught**							
Apr	5	41	34	34	28	6	148	3
May	13	50	46	43	15	8	175	3
Jun	15	48	58	74	52	4	251	4
Jul	1	28	32	33	19	2	115	3
Aug	4	14	29	29	38	6	120	4
Sep	3	13	17	20	41	6	100	4
Total	41	194	216	233	193	32	909	3
Percent	4.5	21.3	23.8	25.6	21.2	3.5	100	-
Combined	25.9		23.8	46.9		3.5	100	-

Table 43 breaks angler trip ratings (numbers and sizes caught) down based on the number of walleye harvested/angler. Ratings tended to be higher based on numbers of fish caught versus the size caught. In both categories, trip rating tended to be favorable (excellent or good rating) when at least two walleye per angler were harvested. These results would indicate that while perhaps not the only important component of trip satisfaction, harvesting fish as part of an overall fishing trip experience is important, at least for certain types of anglers (Gigliotti 1996).

Table 43. Responses of 2003 Lake Francis Case anglers to the question: "How would you rate your fishing today in terms of catching the numbers of fish you were expecting, or …the sizes of fish you were expecting?" by number of walleye harvested. Responses are grouped as excellent/good, fair, and poor/very poor based on the more detailed breakdowns defined in Table 42 and excludes those who indicated no opinion.

No. walleye harvested/ angler	Numbers caught					
	Excellent/Good		Fair		Poor/V.poor	
	No.	Percent	No.	Percent	No.	Percent
4	51	81.0	9	14.3	3	4.8
3 – 3.9	51	70.8	11	15.3	10	13.9
2 – 2.9	59	55.1	33	30.8	15	14.0
1 – 1.9	61	33.0	55	29.7	69	37.3
0.1 – 0.9	25	16.0	38	24.4	93	59.6
0	37	10.7	69	19.9	241	69.5
Total	284	30.5	215	23.1	431	46.3
	Sizes caught					
4	32	72.7	9	20.5	3	6.8
3 – 3.9	32	61.5	13	25.0	7	13.5
2 – 2.9	52	59.1	25	28.4	11	12.5
1 – 1.9	56	32.6	57	33.1	59	34.3
0.1 – 0.9	34	19.3	48	27.3	94	53.4
0	29	8.4	64	18.6	252	73.0
Total	235	26.8	216	24.6	426	48.6

With current management regulations requiring the mandatory release of certain sizes of walleye/sauger, coupled with the voluntary release of a significant number of fish by LFC anglers, how anglers feel about their fishing trip, based on the total number of walleye/sauger caught versus harvested, may also be important. Tables 44 and 45 provide data similar to those presented in Tables 42 and 43, however, responses are categorized by the average number of walleye caught per angler. Similar to results presented in Table 41, over 70% of anglers questioned were still satisfied with their fishing trip despite catching no walleye/ (Table 44). Over 90% of anglers who caught at least 4 – 7.9 walleye/angler indicated that they were satisfied with their trip (Table 44). However, it took a catch of over 16 walleye/angler to increase the percentage of anglers rating their trips as excellent or good, based on the number of fish caught, above 70% (Table 45).

Table 44. Responses of 2003 Lake Francis Case anglers to the question: "Considering all factors, how satisfied are you with your fishing trip today?" by the average number of walleye caught per angler. Responses are grouped as satisfied, dissatisfied and neutral/no-opinion, based on the more detailed breakdowns defined in Table 40.

No. WAE caught/ angler	Satisfied		Dissatisfied		Neutral/No-opinion	
	No.	Percent	No.	Percent	No.	Percent
16 or >	62	92.5	5	7.5	0	0.0
12-15.9	76	89.4	5	5.9	4	4.7
8-11.9	144	94.1	8	5.2	1	0.7
4-7.9	324	90.0	20	5.6	16	4.4
>0-3.9	667	82.4	112	13.8	30	3.7
0	275	70.7	70	18.0	44	11.3
Total	1,548	83.1	220	11.8	95	5.1

Table 45. Responses of 2003 Lake Francis Case anglers to the question: "How would you rate your fishing today in terms of catching the numbers of fish you were expecting?" by the average number of walleye caught per angler. Responses are grouped as excellent/good, fair, and poor/very poor based on the more detailed breakdowns defined in Table 42 and excludes those who indicated no opinion.

No. WAE caught/ angler	Numbers caught					
	Excellent/Good		Fair		Poor/V.poor	
	No.	Percent	No.	Percent	No.	Percent
16	27	77.1	4	11.4	4	11.4
12-15.9	31	62.0	15	30.0	4	8.0
8-11.9	57	64.8	16	18.2	15	17.0
4-7.9	80	45.2	56	31.6	41	23.2
0-3.9	78	19.3	96	23.8	230	56.9
0	11	6.3	28	15.9	137	77.8
Total	284	30.5	215	23.1	431	46.3

A cross comparison (Table 46) of individual responses to trip satisfaction and trip rating questions, would further support the conclusion of Gigliotti (1996), that our angling population is made up of different types of anglers. Each of these different angler types has a different set of values that determine how they evaluate their individual fishing trip. While 83% of LFC anglers indicated they were satisfied (Table 40) with their individual fishing trip, 40 and 41% of that group of satisfied anglers (Table 46) rated their trip as poor or very poor based on the numbers or sizes of fish they caught, respectively. In contrast, of the 12 percent of LFC anglers who were dissatisfied with their trip, 85% of those anglers (Table 46) also rated their trip as poor or very poor based on both the numbers and sizes of fish they caught.

Table 46. Cross comparison of 2003 Lake Francis Case angler responses to questions regarding overall trip satisfaction versus trip ratings, based on number of fish caught, and sizes of fish caught. Percentages are in parentheses.

Trip satisfaction	Trip rating-number caught			
	Excellent/Good	Fair	Poor/V.poor	No opinion
Satisfied	279 (34.8)	196 (24.4)	317 (39.5)	10 (1.2)
Neutral/N.O.	1 (2.0)	9 (18.4)	26 (53.1)	13 (26.5)
Dissatisfied	5 (4.8)	10 (9.6)	88 (84.6)	1 (1.0)
Trip satisfaction	**Trip rating-sizes caught**			
	Excellent/Good	**Fair**	**Poor/V.poor**	**No opinion**
Satisfied	231 (30.9)	195 (26.1)	306 (41.0)	15 (2.0)
Neutral/N.O.	2 (4.3)	10 (21.7)	22 (47.8)	12 (26.1)
Dissatisfied	2 (1.7)	11 (9.5)	98 (84.5)	5 (4.3)

WALLEYE HARVEST MANAGEMENT SURVEY

In recent years, annual walleye harvest on Lake Francis Case has exceeded the management goal of 150,000 fish/year (Stone 1997a, 1998; Stone and Sorensen 1999, 2000, 2001, 2002, 2003, this survey). Continued high fishing use and harvest, coupled with decreasing walleye abundance, prompted LFC biologists to consider a change in sport fish regulations in an effort to reduce annual walleye harvest.

Angler preferences concerning management options are important components of a total fishery. Consequently, LFC biologists compiled a survey to poll LFC anglers to better understand their beliefs concerning proposed regulation changes. Although angler participation is crucial in the management decision making process, biologists must not get distracted from making sound biological decisions, for the overall health of the resource. The questionnaire was distributed as part of the 2003 angler use and harvest survey as well as being dispersed at local bait shops along the entire length of the reservoir. The 2003 Walleye Harvest Management questionnaire is shown in Figure 15.

Figure 15. 2003 Walleye Harvest Management Questionnaire.

Walleye Harvest Management

Issue – In recent years angler harvest of walleye has exceeded management goals (Figure 1), based on the current walleye population abundance.

Background - Lake Francis Case (LFC) anglers have enjoyed excellent walleye fishing over the past decade, however with improvements in boats and fishing technology, more free time, and at times more anglers, walleye harvest from LFC has been exceeding management objectives for a number of years.

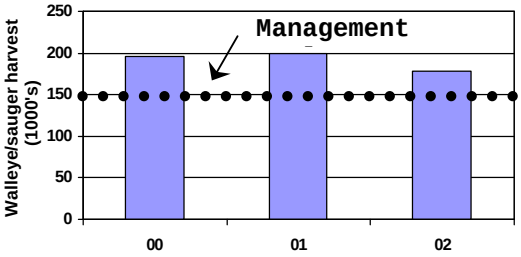


Figure 1.

Traditionally, over 50 percent of the annual fishing pressure (Figure 2) and walleye harvest (Figure 3) takes place during the months of May and June. During this time period fishing pressure and walleye harvest is fairly evenly spread out over the upper (Chamberlain), middle (Platte) and lower (L. Andes/Pickstown) portions of the reservoir.

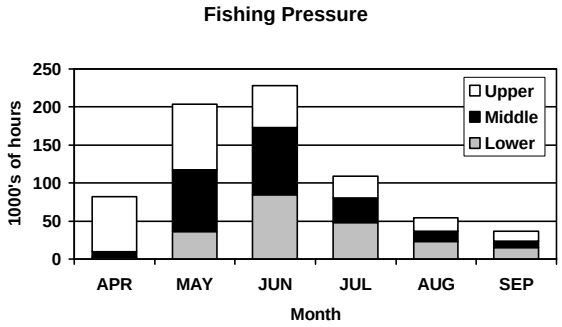


Figure 2.

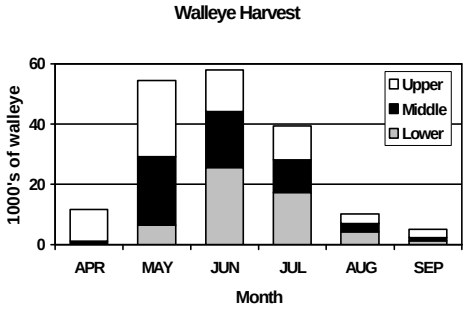


Figure 3.

A common misconception is that "everyone is catching limits", survey data over the past five years shows that just over 30% of the LFC angling parties even harvest two walleye per person per trip. The harvest is spread out over lots of anglers and fishing trips.

In the mid-to-late 1990s the LFC walleye population, partially in response to the high water conditions of the mid-1990s, was near record abundance (Figure 4). However, as water conditions have declined the LFC walleye population can no longer sustain the high harvest levels that have occurred over the past five or six years. Additionally, poor walleye reproduction in 2001 will begin to impact the number of walleye available for harvest next year. If efforts to reduce the annual harvest of walleye from LFC are not undertaken the walleye population and sport fishery will probably begin to go through a series of peaks and valleys.

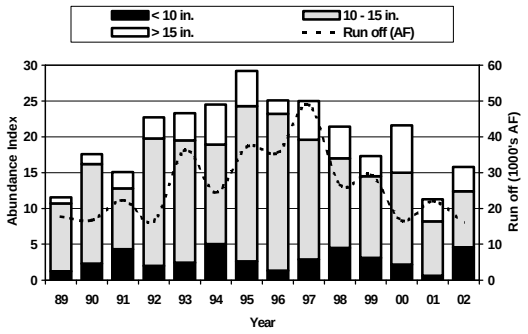


Figure 4.

Proposal – A reduction in the winter/spring daily walleye limit from four walleye per angler per day to two walleye per angler per day. The possession limit would remain at eight walleye per angler. After a selected date the daily limit would again return to four walleye per day per angler.

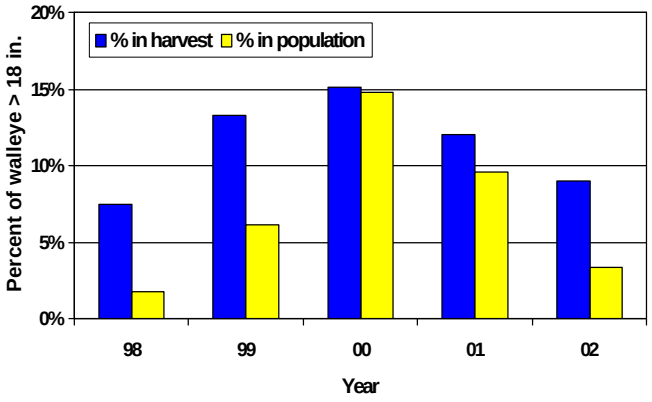
Management Goal - The goal of this proposed change would be to reduce the annual harvest of walleye from LFC by about 25 percent while allowing LFC anglers the opportunity to fish year-round.

Figure 15 continued…

Large Walleye Management

Issue - Many LFC anglers have now come to appreciate and value having larger walleye in the fishery. They enjoy the opportunity to catch them but question whether they need to be harvested. Since many LFC anglers don't consider a walleye between three and eight pounds a real trophy, some anglers have suggested that SD GFP consider increasing the length requirement for the "one walleye over 18 inches" regulation to offer more protection to those larger fish.

Background - In 1999 walleye management regulations for Lake Francis Case (LFC) were changed allowing anglers to only harvest one walleye per angler per day over 18 inches. Overall, that regulation has been successful at spreading the harvest of walleye over 18 inches to more anglers, but it has not really reduced the numbers of them that are harvested on an annual basis. In fact many anglers are able to target those larger fish and even appear to feel that to have a successful day walleye fishing on LFC you have to "get your one walleye over 18 inches". As the figure to the right shows, in four out of the past five years LFC have harvested walleye over 18 inches in greater numbers than their overall percentage in the population.



Proposal - Suggestions have included increasing the "one walleye over 18 inch" regulation to "one walleye over 20, 22 or even 24 inches.

Management Goal - The goal of this proposed change would be to increase the opportunity to catch walleye over 18 inches, but decrease their harvest since this proposed change would require that walleye between 18 inches and the new larger size (i.e. 22 inches) would have to be released.

For Further Information, Questions or Comments Contact:

Figure 15 continued…

Your Thoughts

The opinions of anglers who fish LFC are highly valued and we would appreciate hearing from you.

Walleye Harvest Management

In regards to proposed changes in LFC walleye harvest management what options would you prefer, please check (\) your preference below:

TT No Change – leave the current daily walleye limit as it is.

TT Yes, reduce the winter/spring walleye limit on Lake Francis Case from the current four walleye/angler/day to two walleye/angler/day (possession limit would remain at eight walleye/angler).

I would suggest the reduced limit be in effect from:
π January 1 through April 30 π January 1 through May 30
π January 1 through May 15 π Other (please list):_____

π Other walleye harvest reduction idea (please list): _____

_____

Comments -

Large Walleye Management

In regards to proposed changes in large walleye management on LFC what options would you prefer, please check (\) your preference below:

π No Change – leave the current "one walleye over 18 inches per angler per day" regulation as it is.

π Yes, increase the length of the current "one walleye over 18 inches per angler per day" to a larger size. (i.e. walleye between 18 inches and the size selected would be protected")

The size I would suggest is:
π 20 inches π 24 inches
π 22 inches π Other (please list):_____ inches

π Other large walleye management idea (please list): _____

_____

π I am a South Dakota resident π I am not a resident of South Dakota

Comments -

Thank you

Survey

ID:_____

Walleye Harvest Management

Lake Francis Case anglers were asked to select which proposed management option they preferred (Figure 15). Seventy three percent of those responding believed a reduction in the daily limit for walleye was needed (Table 47). Thirty one percent of those responding favored the January 1 through May 15 timeframe for a reduced daily walleye limit, while 30% favored the January 1 through April 30 timeframe. Table 48 reports the same data as Table 47 with results for South Dakota residents and non-residents reported separately. Non-Resident anglers supported a reduced daily walleye limit more than South Dakota residents did (Table 48). Nearly 36% of resident anglers favored the January 1 through May 15 timeframe for a reduced daily walleye limit, while 42% on non-resident anglers favored the January 1 through April 30 timeframe (Table 48).

Table 47. Preferences of 2003 Lake Francis Case Anglers for proposed walleye harvest management options. Percentages are presented and the number of responses is in parentheses.

No Change	27% (66)				
		TIMEFRAME			
Reduce Daily Limit		**JAN 1-APR 30**	**JAN 1-MAY 15**	**JAN 1-MAY 31**	**OTHER**
	73% (179)	30% (53)	31% (55)	23% (41)	16% (30)

Table 48. Preferences of 2003 Lake Francis Case Anglers for proposed walleye harvest management options. Percentages are presented and the number of responses is in parentheses.

South Dakota Residents					
No Change	23% (35)				
		TIMEFRAME			
Reduce Daily Limit		**JAN 1-APR 30**	**JAN 1-MAY 15**	**JAN 1-MAY 31**	**OTHER**
	77% (117)	26% (30)	36% (42)	24% (29)	14% (16)
Non-Resident Angers					
No Change	15% (9)				
		TIMEFRAME			
Reduce Daily Limit		**JAN 1-APR 30**	**JAN 1-MAY 15**	**JAN 1-MAY 31**	**OTHER**
	85% (53)	42% (22)	19% (10)	20% (11)	19% (10)

Large Walleye Management

Lake Francis Case anglers were asked whether or not they believed an increase in the “one over” length regulation was needed (Figure 15). Fifty-eight percent of those responding believed an increase in the “one over” length restriction was needed (Table 49). Table 49 displays survey results from the large walleye management section of the survey. Table 50 shows the same results broken down by resident and non-resident anglers. In general, responses for resident and non-resident anglers were similar (Table 50).

Table 49. Preferences of 2003 Lake Francis Case Anglers to proposed large walleye management options. Percentages are presented and the number of responses is in parentheses.

No Change	42% (102)					
		Preferred Length				
Increase Length		**20”**	**22”**	**24”**	**OTHER SIZE**	**OTHER IDEA**
	58% (143)	33 (47)	29% (41)	25% (36)	6% (9)	7% (10)

Table 50. Preferences of 2003 Lake Francis Case Anglers to proposed large walleye management options. Percentages are presented and the number of responses is in parentheses.

South Dakota Residents						
No Change	46% (69)					
		Preferred Length				
Increase Length		**20”**	**22”**	**24”**	**OTHER SIZE**	**OTHER IDEA**
	54% (82)	28% (23)	28% (23)	28% (23)	9% (7)	7% (6)
Non-Resident Angers						
No Change	40% (25)					
		Preferred Length				
Increase Length		**20”**	**22”**	**24”**	**OTHER SIZE**	**OTHER IDEA**
	60% (37)	16% (6)	41% (15)	27% (10)	8% (3)	8% (3)

DISCUSSION

Lake Francis Case, supporting one of South Dakota's most important walleye fisheries, continues to attract anglers from across the upper Midwest. Walleye, ranked the favorite species by 69% of respondents to a 1992 survey of South Dakota anglers (Mendelsohn 1994), continued to remain the target species of most LFC anglers. Since a peak in total walleye abundance in 1995, the LFC walleye population has generally declined in abundance. That decline has been attributed, in part, to continued high harvest coupled with continuing drought conditions in the Missouri River basin. From 1996 through 2001, the estimated LFC walleye harvest has been near or exceeded 200,000 fish, peaking at over 339,000 in 1998. This high harvest, coupled with low recruitment in 2000, 2001 and 2002 will begin to impact the number of legal-size walleye available for harvest beginning in 2004. This survey suggests that a significant portion of the initially abundant 2002 LFC walleye year class did not recruit to age 1, so the expected downturn in population abundance may be longer in duration than previously thought. Walleye growth rates in 2003, which had declined in 2000, remained similar to the 2001 and 2002 values and were probably maintained by moderate gizzard shad recruitment. Walleye growth rates will need to be watched closely in future surveys as the walleye population responds to modifications in size limit regulations and fluctuations in gizzard shad abundance. Walleye condition, as indexed by W_r, has remained unchanged since the 1990 regulation changes, despite variability in walleye and gizzard shad abundance over that same time period.

Water yield in the Missouri River system ranged between two extremes during the decade of the 1990's; from the drought of the late 1980's and early 1990's to the record water yield measured in 1997. These extremes in water yield undoubtedly played a significant role in shaping the fish populations of LFC. While changes to walleye management regulations in 1990 were given much of the credit for restructuring the LFC walleye population, resulting in the outstanding fishing that occurred throughout the latter half of the 1990's, the high water yield in the mid-1990's played a role that cannot be overlooked (Stone and Lott 2002). While walleye population abundance, size structure, and growth were showing positive trends in the early 1990's, when drought conditions still existed, the high walleye abundance levels reached in 1997

and 1998 were probably the result of improved habitat and nutrient conditions created by high water yield in 1995 and 1997 (Stone 1997b). As water yield in the Missouri River basin returns to normal or below normal levels, it is unrealistic to expect that the high walleye abundance of recent years can be maintained in the near future.

Recent modifications, in 1999 and 2001, to walleye sport fishing regulations, have reduced walleye harvest rates, however overall harvest remains high due to continued high fishing pressure. Improvements in walleye population structure, as a result of length limit regulations, is reflected in the 410 mm (16.2 in.) mean length of walleye harvested over the past five years, versus the 380 mm (15.0 in.) average the previous nine years, and the 343 mm (13.5 in.) average estimated in 1989. However, despite a decline in overall walleye population abundance the past several years, a high proportion of anglers are still attaining the daily creel limit of four walleye during certain periods of the year. In this regard, the daily creel limit remains an important factor in the regulation of the fishery and distribution of the walleye harvest, at least during years of high walleye abundance or harvest, as experienced over the past six years. Survey results also suggests that while most LFC anglers are satisfied with their overall fishing trip experience, they can be less satisfied (based on trip rating) with the numbers and sizes of fish that they caught.

Smallmouth bass, which in previous years had ranked second in the sport fishery in terms of total fish caught (harvest and released), have increased in angler catches in recent years reflecting the increase in their overall abundance. Initially introduced as an alternative species that could direct fishing pressure away from walleye, they are now the target species of a small portion of LFC anglers. Smallmouth bass abundance, as measured by spring electrofishing has increased for the past two years as a result of two consecutive years of low-to-moderate reproduction. However, this survey indicates only low smallmouth bass reproduction in 2003. It is hoped that a slight decrease in recruitment observed in this survey will not hinder an increase in smallmouth abundance, because of the importance of bass to the overall LFC sport fishery. In a 1992 survey of South Dakota anglers (Mendelsohn 1994) smallmouth bass were ranked in the top half of 14 species listed as most favorite by over 65% of the respondents. Channel catfish and sauger populations have increased in abundance over recent years and are capable of supporting additional harvest.

Results from these surveys document the contribution and importance of the LFC fishery to the overall angling opportunities provided by the Missouri River system in South Dakota. Lake Francis Case continues to meet or exceed the objective of providing 100,000 angler days of recreation annually, as established in the Missouri River Fisheries Program Strategic Plan (SDGFP 1994). However, with declining walleye abundance, coupled with continued high fishing pressure and walleye harvest, and the return of Missouri River basin water yield to normal or below normal conditions, the near future of the LFC sport fishery is somewhat uncertain. While overall walleye abundance in LFC has decreased, the current population structure should support a sport fishery in 2004. However, anglers fishing Lake Francis Case in 2004 should expect lower walleye harvest rates than those experienced in 2003. A conservative walleye harvest in 2004 is needed to lessen the degree of reduction in fishery quality that anglers may begin seeing in 2005.

High angler catch rates and excessive fishing pressure, combined with reduced overall walleye abundance and continuing drought conditions in the basin, will continue to have an effect on the Lake Francis Case walleye population in the near future. Results from the 2003 walleye harvest management survey indicate that anglers are supportive of a reduced daily limit for at least a portion of the year. To help reduce the effect of high harvest during the times of the year when walleye are most vulnerable to anglers, a reduced daily limit for walleye should be considered.

Prey fish abundance remains an additional area of concern. The LFC walleye population relies heavily on annual production of age-0 gizzard shad as prey. A missing year class of shad could greatly impact the growth and condition of LFC walleye. Continued monitoring of fish populations and associated sport fisheries through annual surveys is essential in providing fisheries managers the ability to monitor and react to the complexity of changing conditions in fish populations, sport fishing demographics, angler expectations, and reservoir operation.

Factors that will shape the future of this walleye fishery over the next several years include:

1) As discussed previously, history suggests that this walleye fishery is not capable of sustaining the harvest that occurred over the past five years, partially attributed to the unusually high water yield in the Missouri River Basin in the mid-late 1990s. If water yield in the basin remains at or below normal, it is expected that the reservoir will be unable to sustain the high walleye abundance and associated sport fish harvest that has occurred over the past eight years. Walleye harvest from LFC will need to become more conservative at lower walleye abundances.

2) Reproduction and recruitment of gizzard shad, emerald and spottail shiners, and yellow perch is essential for good growth of major sport fish species. These species provide the majority of fish prey species in the reservoir.

3) Initial results from the 2002 gill net survey suggested that good-to-excellent walleye production occurred. However, these fish did not materialize as age-1 fish in 2003 and were essentially lost from the population. Therefore, the downturn in overall walleye abundance will last longer than initially thought and will impact Lake Francis Case anglers at least until 2007, and possibly longer, if there is not good-to-excellent walleye recruitment in 2004.

RECOMMENDATIONS

1. Continue and strive to improve reservoir fish population and creel surveys, as described in this report, on an annual basis. These surveys are essential for providing basic information on fish population abundance, reproduction and recruitment, growth and condition, survival and mortality, and sport fish use and harvest. Also, these surveys provide evaluation of progress towards objectives outlined in the Missouri River Fisheries Program Strategic Plan.

2. Revise and update the 1997 Lake Francis Case Fisheries Management Plan, with species specific goals, objectives, and management philosophies for walleye, smallmouth bass and paddlefish.

3. Continue public education efforts focusing on increasing angler awareness and compliance with recent walleye fishing regulation changes and the responsible use and harvest of LFC fisheries resources.

4. Continue annual review and evaluation of sport fishing regulations and their effectiveness.

5. Continue walleye tagging efforts on fish greater than 500 mm. Tagging data from 2001 suggested excessive exploitation of larger walleye. Data is needed to determine if this was a random occurrence or a consistent trend.

5. Continue to incorporate angler attitude and preference questions in routine creel survey sampling. This technique provides valuable information with very little additional expense.

6. Continue standardized spring smallmouth bass electrofishing sampling. This technique is providing a more reliable long-term data set than fall gill netting.

7. Future research projects that need to be considered and developed include:
   - a study to evaluate LFC smallmouth bass distribution and movement related to the annual fall draw-down of the reservoir.
   - a study to document LFC gizzard shad life history with special emphasis on spawning and over wintering habitat.
   - working with researchers at South Dakota State University to continue studies to evaluate the effects of inter-basin transfer of nutrients, zooplankton and fish between South Dakota Missouri River reservoirs on fish population status.
8. Increase public awareness of aquatic nuisance species as they threaten to continue their invasion of Missouri River waters.

9. Continue to document threatened and endangered fish observations and locations.

10. Conduct bi-monthly zooplankton sampling, as done prior to 2000, as a method to index reservoir productivity.

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APPENDICES

Appendix 1. Monthly water volume (1000's acre-feet) released through (power) or over (spill) Ft. Randall Dam, 1999-2003.

Month	1999		2000		2001		2002		2003	
	Power	Spill	Power	Spill	Power	Spill	Power	Spill	Power	Spill
Jan	1,295	0	1,172	0	681	0	672	0	792	0
Feb	1,215	0	745	0	615	0	594	0	611	0
Mar	1,609	0	1,205	0	591	0	976	0	931	0
Apr	1,114	0	1,540	0	208	0	1,204	0	1,355	0
May	1,570	0	1,796	0	783	0	1,266	0	1,464	0
Jun	1,786	0	1,842	0	1,051	0	1,432	0	1,453	0
Jul	1,953	3	1,834	0	1,250	0	1,619	0	1,494	0
Aug	2,292	0	1,765	9	1,566	0	1,773	0	1,504	0
Sep	2,425	38	1,852	12	1,548	0	1,807	0	1,671	0
Oct	2,226	5	1,872	0	1,620	0	1,808	0	1,664	0
Nov	2,273	165	1,569	0	1,455	0	1,363	0	1,205	0
Dec	1,350	3	848	0	672	0	662	0	725	0
Total	21,108	214	18,040	21	12,040	0	15,176	0	14,869	0

Appendix 2. Common and scientific names of fishes mentioned in this report.

Common name	Scientific name	Abbreviation
Bigmouth buffalo	*Ictiobus cyprinellus*	BIB
Black bullhead	*Ameiurus melas*	BLB
Black crappie	*Pomoxis nigromaculatus*	BLC
Bluegill	*Lepomis macrochirus*	BGL
Brown trout	*Salmo trutta*	BNT
Channel catfish	*Ictalurus punctatus*	CCF
Common carp	*Cyprinus carpio*	CAP
Common shiner	*Notropis cornutus*	CMS
Emerald shiner	*Notropis atherinoides*	EMS
Fathead minnow	*Pimephales promelas*	FHM
Flathead catfish	*Pylodictis olivaris*	FCF
Freshwater drum	*Aplodinotus grunniens*	FRD
Gizzard shad	*Dorosoma cepedianum*	GIS
Goldeye	*Hiodon alosoides*	GOE
Johnny darter	*Etheostoma nigrum*	JOD
Largemouth bass	*Micropterus salmoides*	LMB
Northern pike	*Esox lucius*	NOP
Northern redbelly dace	*Phoxinus eos*	NRD
Paddlefish	*Polyodon spathula*	PAH
Rainbow trout	*Oncorhynchus mykiss*	RBT
Red shiner	*Notropis lutrensis*	RES
River carpsucker	*Carpiodes carpio*	CPS
Sauger	*Sander canadense*	SAR
Shorthead redhorse	*Moxostoma macrolepidotum*	SHR
Shortnose gar	*Lepisosteus platostomus*	SNG
Shovelnose sturgeon	*Scaphirynchus platorynchus*	SNS
Silvery minnow	*Hybognathus nuchalis*	SIM
Smallmouth bass	*Micropterus dolomieu*i	SMB
Smallmouth buffalo	*Ictiobus bubalus*	SAB
Spottail shiner	*Notropis hudsonius*	SPS
Walleye	*Sander vitreum*	WAE
White bass	*Morone chrysops*	WHB
White crappie	*Pomoxis annularis*	WHC
Yellow perch	*Perca flavescens*	YEP

Appendix 3. Standard weight equations used for relative weight calculations. Length is in millimeters, weight is in grams, and logarithms are to the base 10.

Walleye	LogWs = 3.180*LogTL-5.453
Sauger	LogWs = 3.187*LogTL-5.492
Smallmouth bass	LogWs = 3.200*LogTL-5.329
Channel catfish	LogWs = 3.294*LogTL-5.800
Yellow perch	LogWs = 3.230*LogTL-5.386
White bass	LogWs = 3.081*LogTL-5.066

Appendix 4. Total length (TL;mm) - weight (WT;g) regression equations for walleye, sauger, and smallmouth bass from Lake Francis Case, and mean total lengths and weights. Logarithms are to the base 10. *N* = sample size. Mean (X) total lengths and weights do not include age-0 fish.

Species	**Year**	***N***	**Equation**	**R^2**	**X TL (mm)**	**X WT (gm)**
Walleye	1999	382	LogWT=3.058LogTL-5.235	0.99	317	322
	2000	523	LogWT=3.133LogTL-5.417	0.99	355	428
	2001	288	LogWT=3.209LogTL-5.613	0.99	335	357
	2002	306	LogWT=3.095LogTL-5.326	0.99	340	369
	2003	230	LogWT=3.160LogTL-5.498	0.97	324	324
Sauger	1999	117	LogWT=3.163LogTL-5.569	0.98	338	312
	2000	146	LogWT=3.063LogTL-5.322	0.98	323	267
	2001	128	LogWT=3.240LogTL-5.751	0.98	320	257
	2002	120	LogWT=3.044LogTL-5.267	0.98	322	256
	2003	88	LogWT=3.101LogTL-5.417	0.97	310	240
SM bass	1999	13	LogWT=3.363LogTL-5.702	0.97	239	212
	2000	23	LogWT=3.074LogTL-4.966	0.98	292	453
	2001	12	LogWT=3.277LogTL-5.463	0.99	258	400
	2002	30	LogWT=3.104LogTL-5.061	0.99	258	309
	2003	20	LogWT=3.171LogTL-5.216	0.99	248	264

Appendix 5. Channel catfish, white bass, and yellow perch proportional stock density (PSD), relative stock density (RSD-P and RSD-M), and relative weight (W_r), for 1999-2003, for fish collected from Lake Francis Case. *N* = sample size.

Species	1999				2000				2001				2002				2003			
	PSD	RSD		W_r	PSD	RSD		W_r	PSD	RSD		W_r	PSD	RSD		W_r	PSD	RSD		W_r
		P	M			P	M			P	M			P	M			P	M	
Channel catfish	56	0	0	81	44	1	0	76	27	4	0	79	35	1	0	76	26	1	0	78
N =	127				101				109				139				141			
White bass	100	89	67	107	90	86	24	107	91	91	27	104	100	50	42	99	95	85	32	106
N =	9				21				33				12				39			
Yellow perch	25	0	0	80	35	0	0	82	50	50	0	86	11	0	0	78	13	0	0	76
N =	32				17				6				9				16			